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SPECIAL REPORT

STRATEGIC ENGINEERING STUDY

NO. 131

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SAMAR AND LEYTE (P.I.)

TERRAIN INTELLIGENCE

Prepared by
GEOLOGICAL SURVEY, U.S. DEPARTMENT OF THE INTERIOR
Under direction of
CHIEF OF ENGINEERS, U.S. ARMY

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AUGUST, 1944

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9-44 1944

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SPECIAL REPORT

TRATEGIC ENGINEERING

NO. 131

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SAMAR AND LEYT

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TERRAIN INTELLIGE

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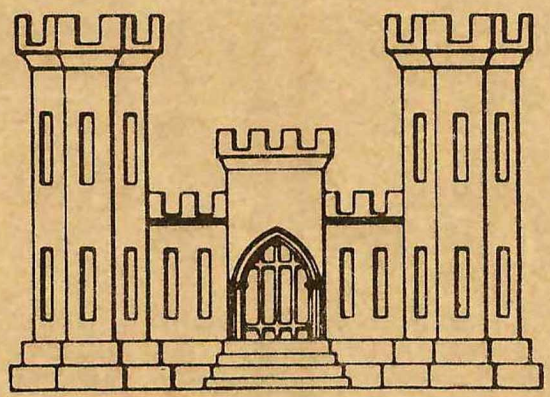
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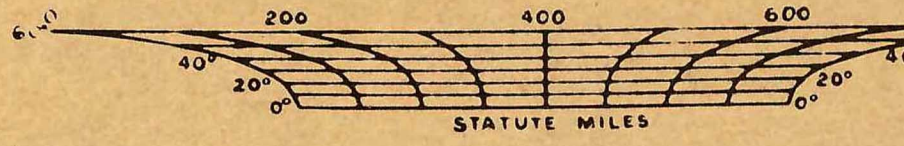
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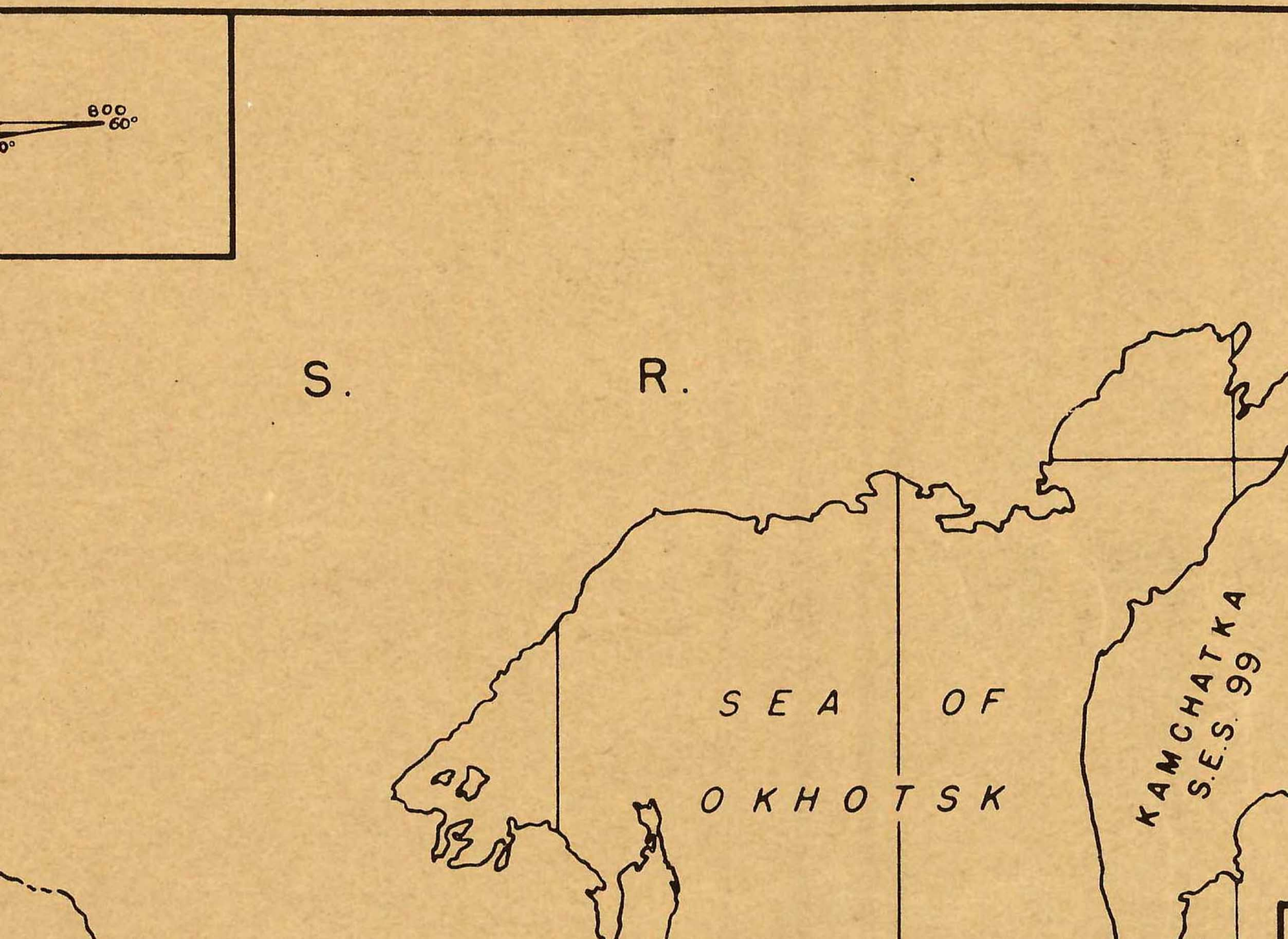
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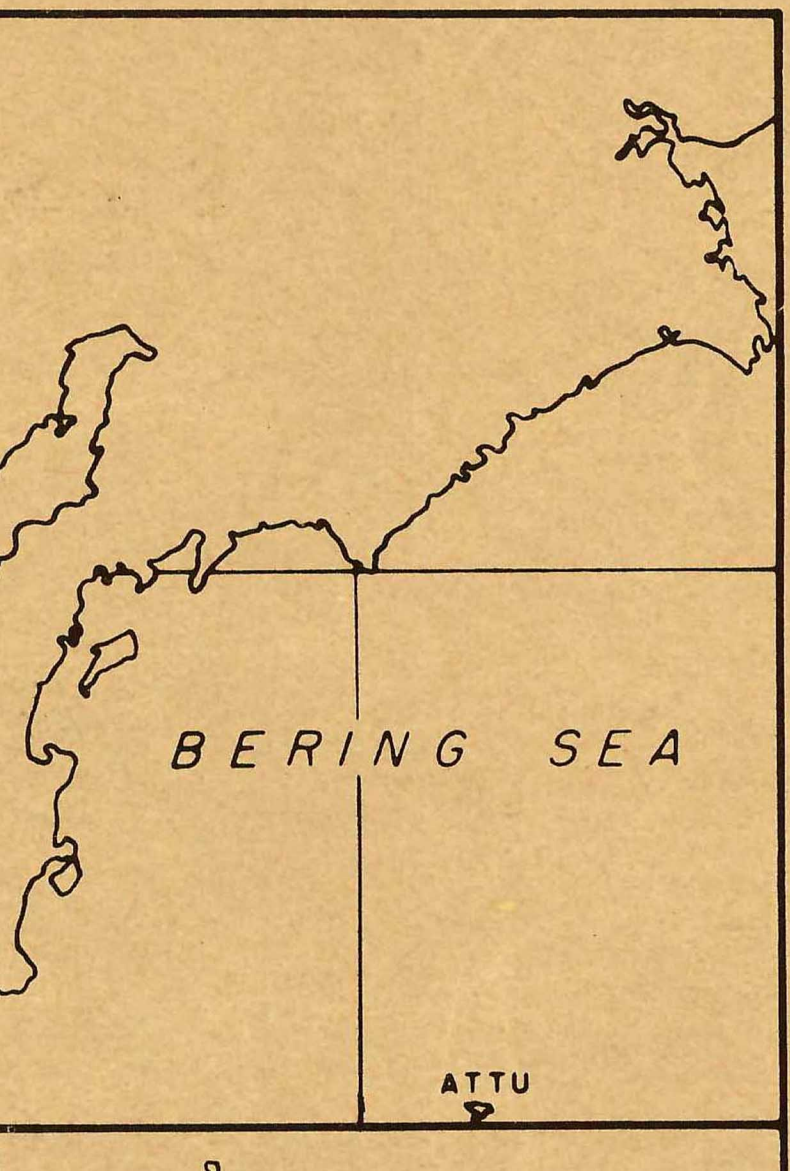


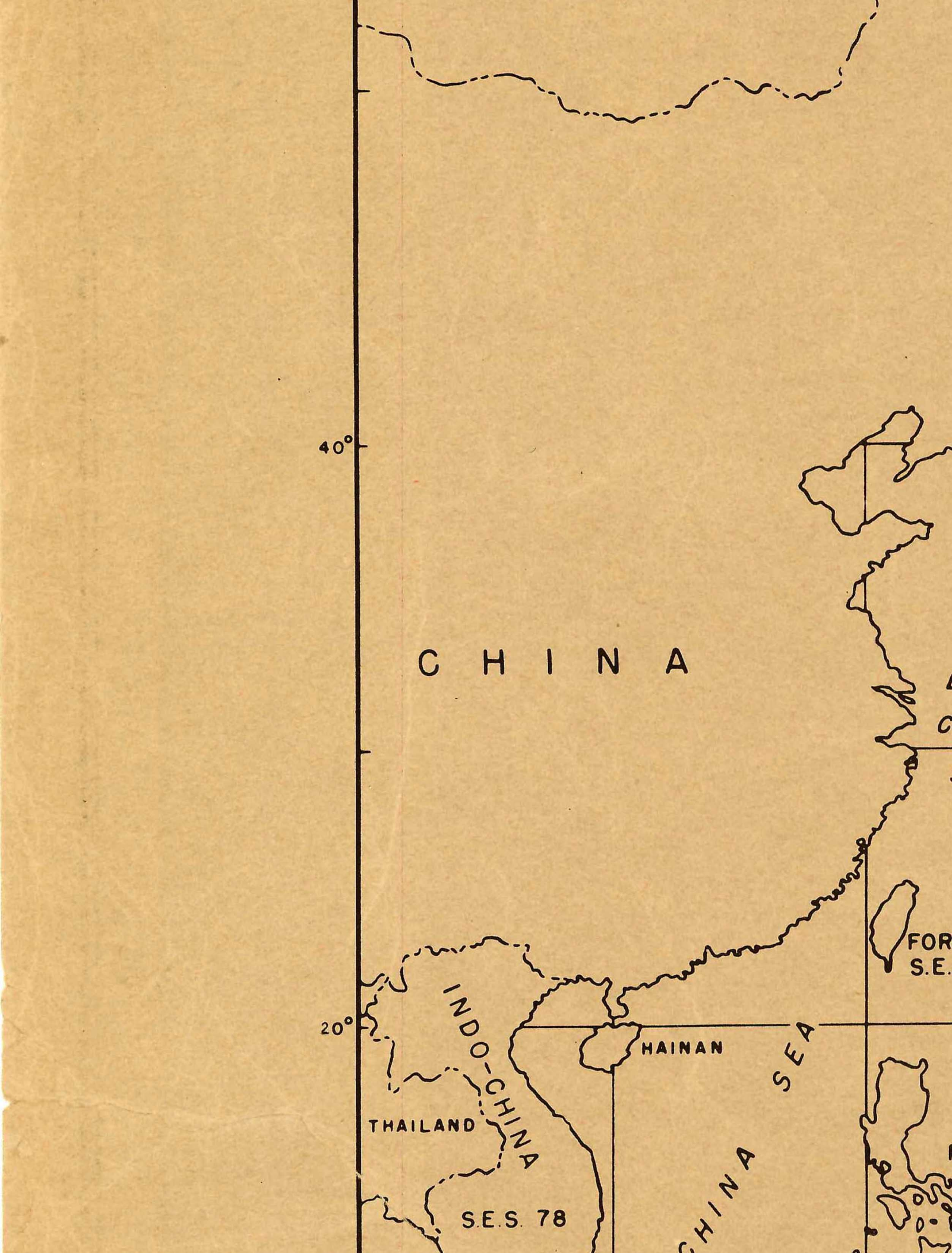
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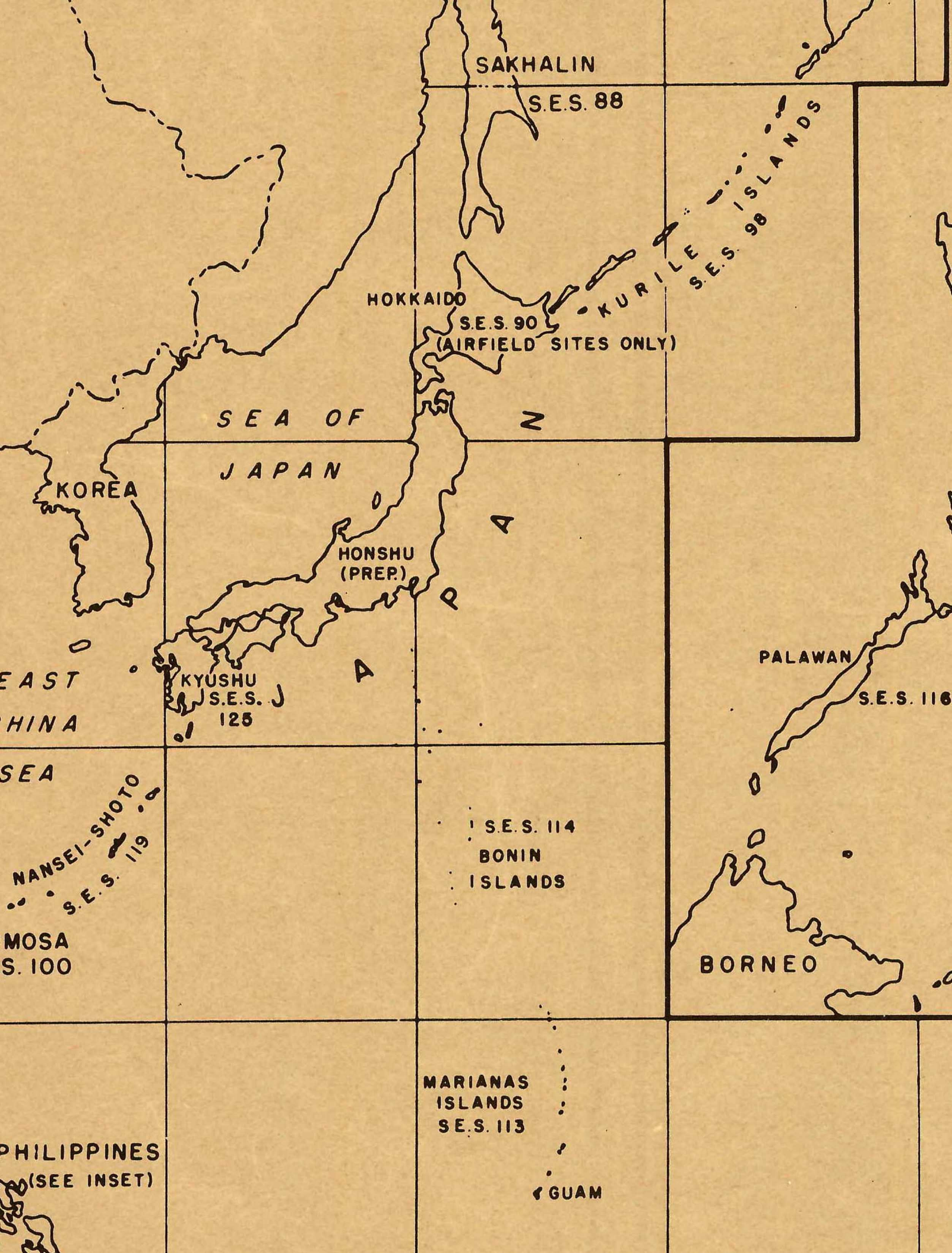
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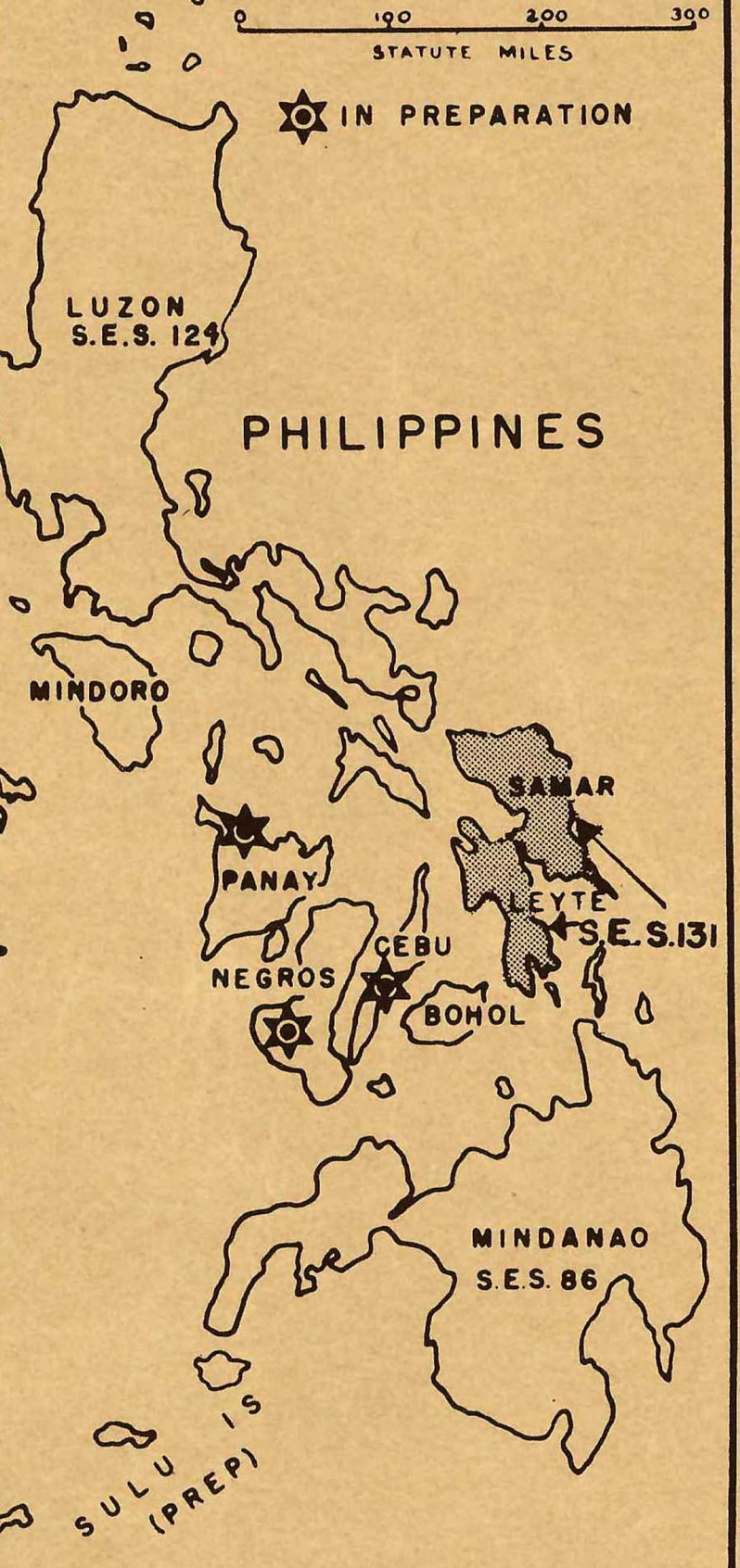
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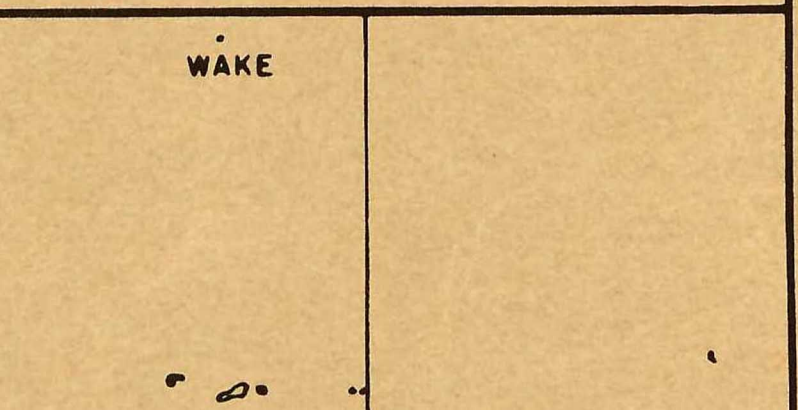



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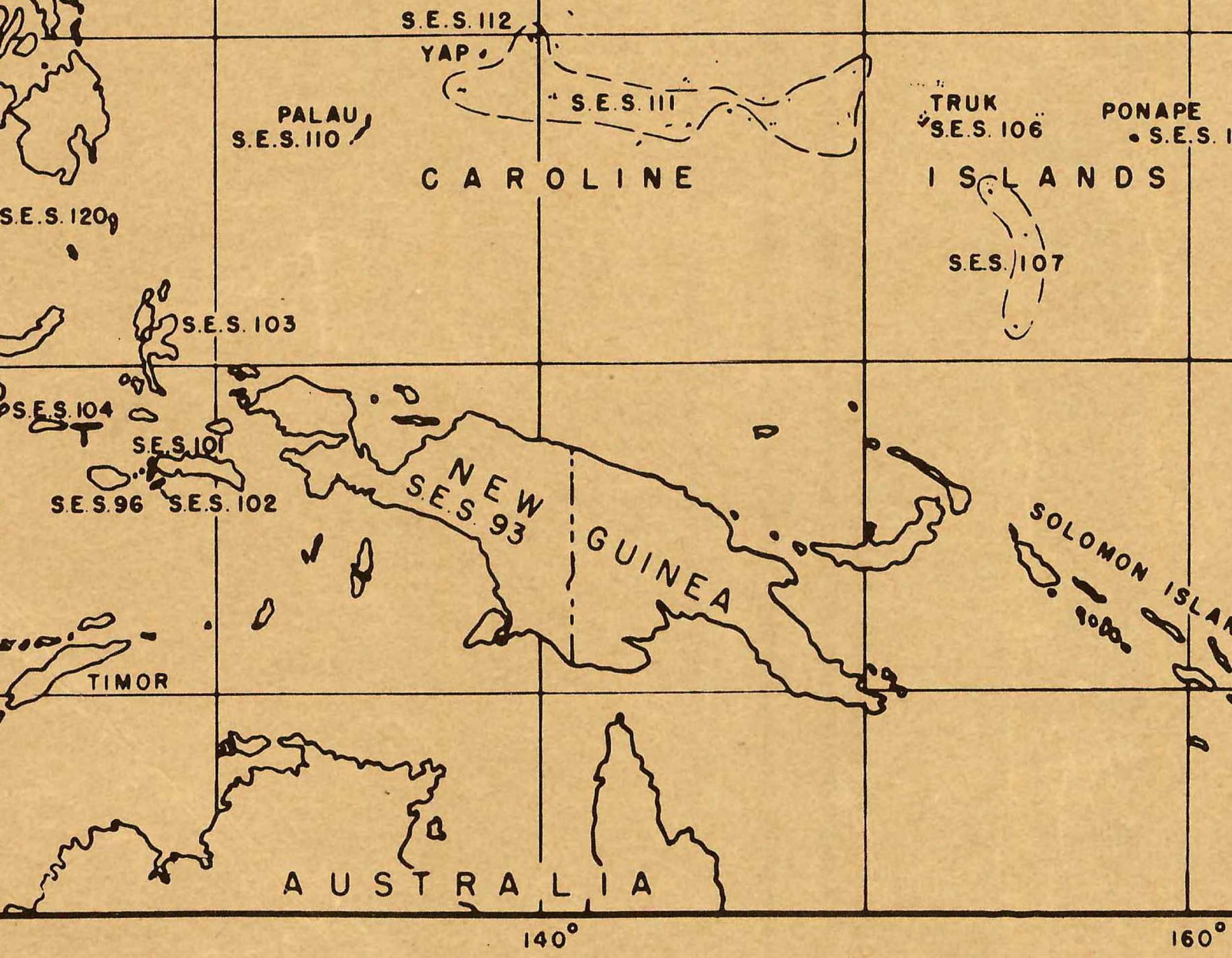

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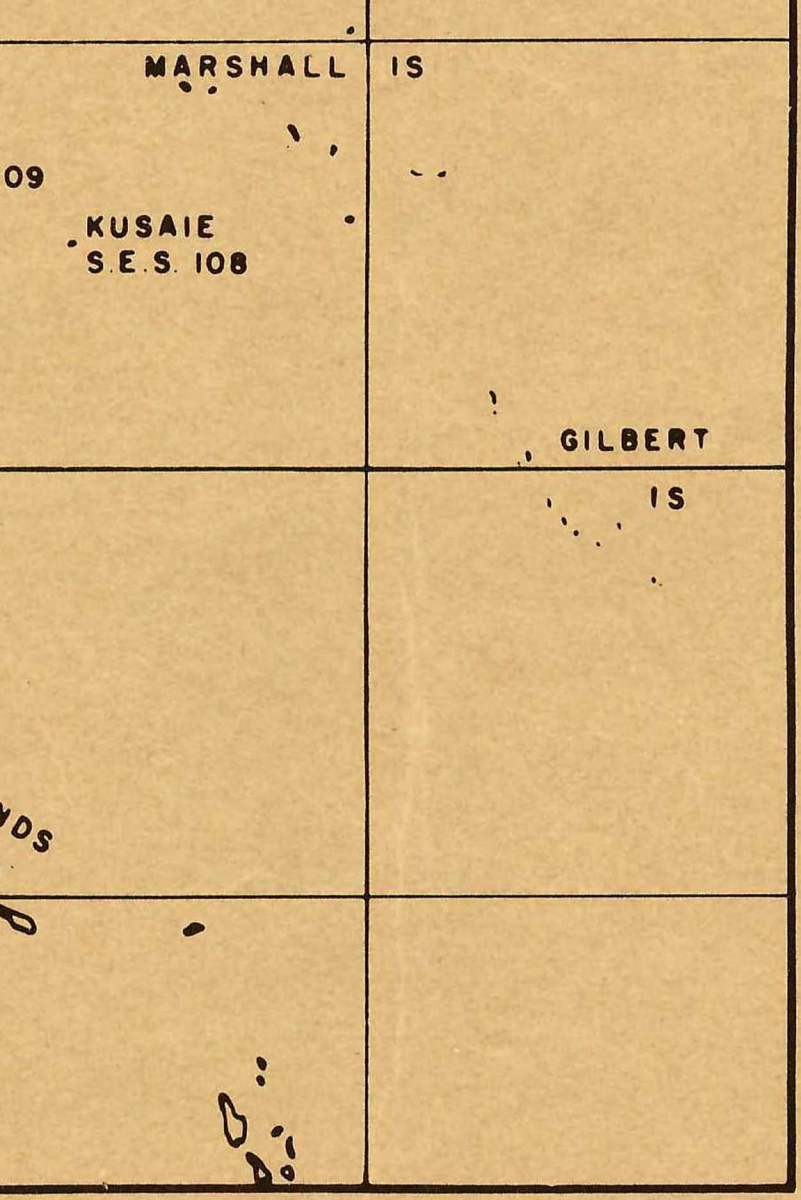

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14. ABSTRACT

This report was prepared by the Geological Survey for the Chief of Engineers, during the months of July-August 1944. It describes those terrain features of Samar and Leyte and some neighboring islands that are of military significance. Each map and its accompanying table, is devoted to a specialized problem; together they present a regional picture of the character of the country, and the relationship of terrain to movement, airdrome sites, road construction and maintenance problems, water supply and and nature and location of principal types of construction materials, geology and soils. Climate and vegetation are considered briefly; other intelligence reports should be consulted for detailed information. Terrain studies of Samar and Leyte Islands, Republic of the Philippines. Includes terrain appreciation; general features and coastal detail; water supply; construction; airdrome sites; roads; soil; construction materials; geology; vegetation; climate. Includes tables, B&W photos, maps.

15. SUBJECT TERMS

Biliran Island; Camotes Islands; Leyte Gulf; Samar Island; Leyte Island; climate; coastal detail; construction materials; drainage; geographical features; geology; roads; Philippines; rainfall; rivers; San Bernardino Strait; soils; terrain; topography; topology; trafficability; vegetation; water supply.

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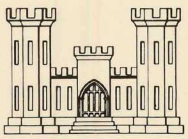
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NO. 131

SAMAR AND LEYTE (P.I.)

TERRAIN INTELLIGENCE

Prepared by
SECTION OF MILITARY GEOLOGY
GEOLOGICAL SURVEY, U.S. DEPARTMENT OF THE INTERIOR
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ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 201543
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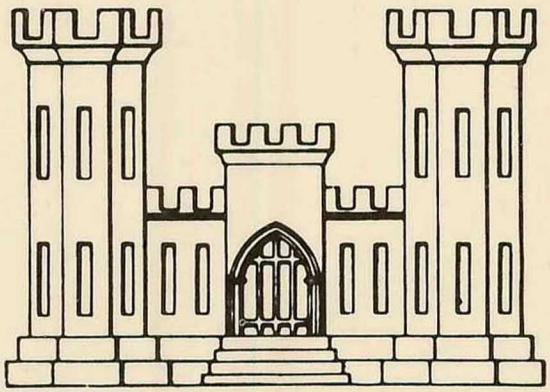
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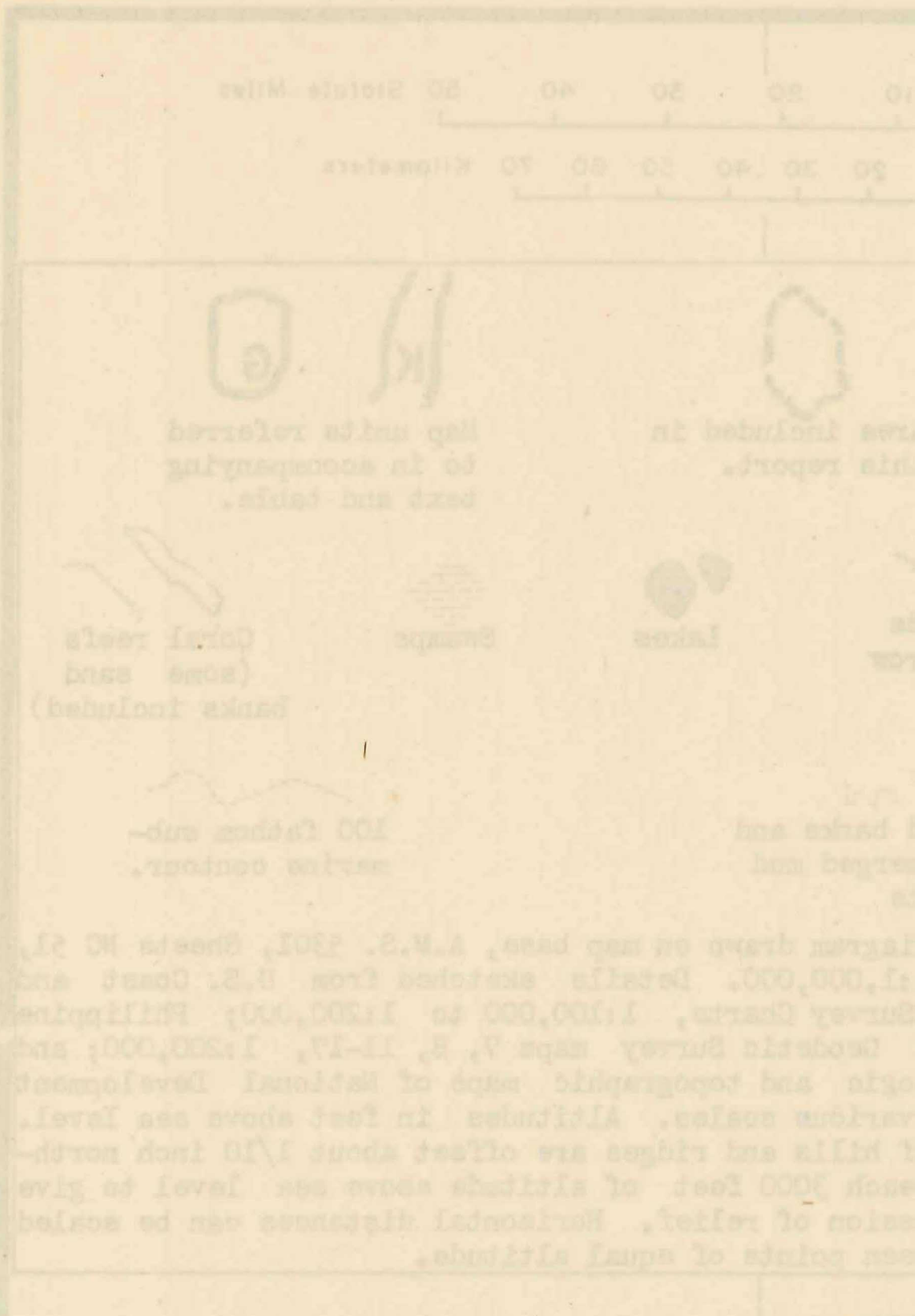
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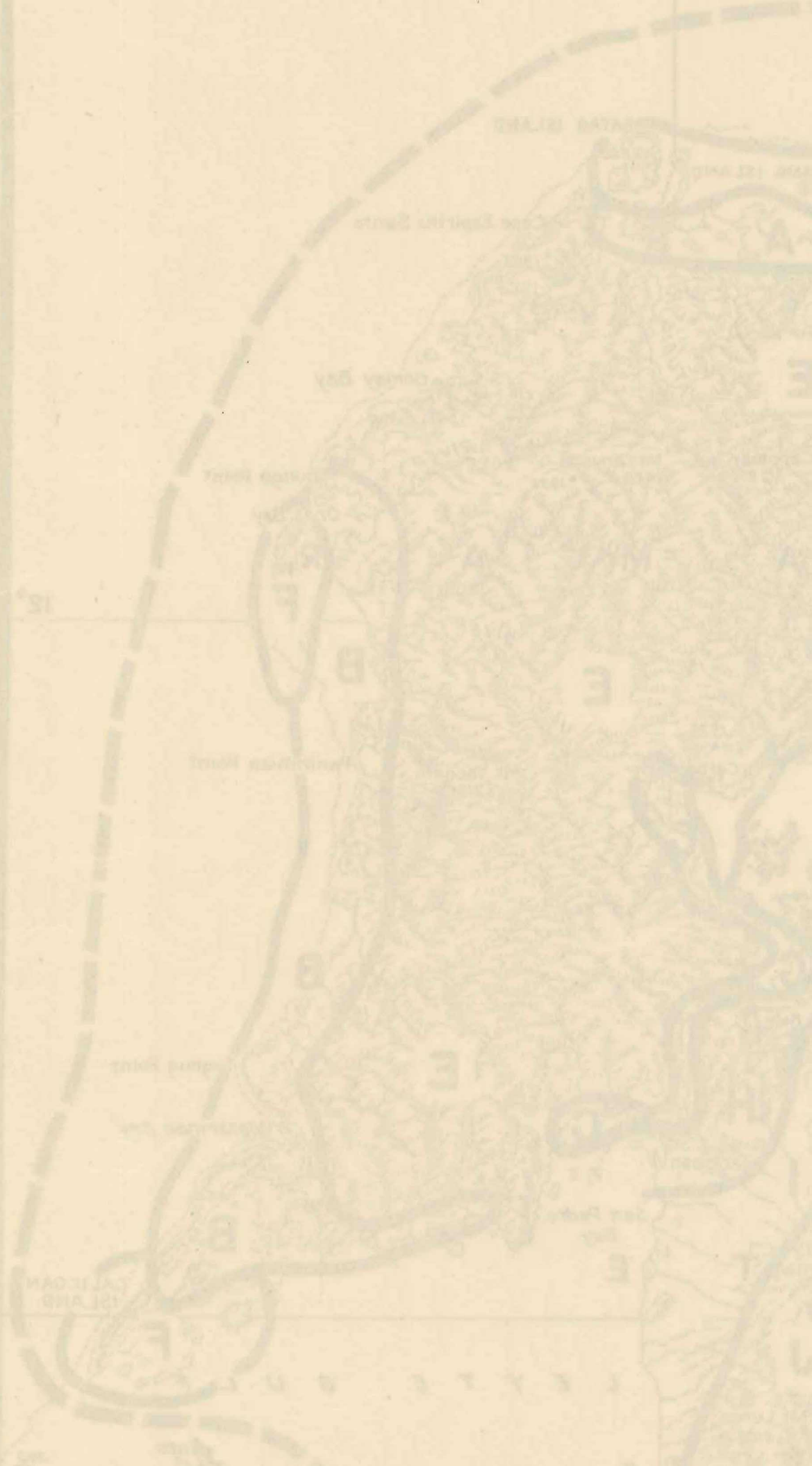
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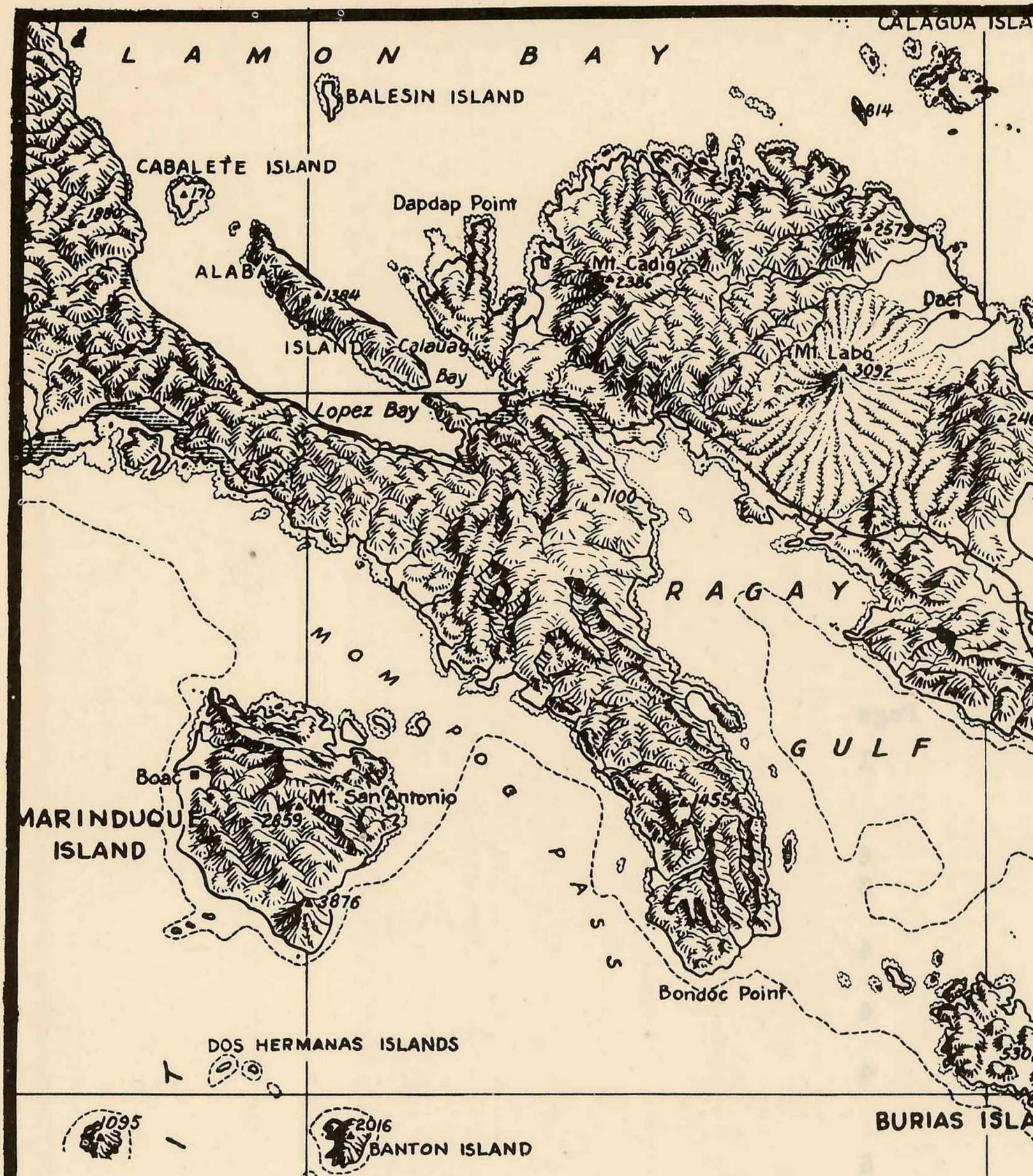
SUMMARY OF TERRAIN SITUATION

SAMAR AND LEYTE (P.I.)



PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SUMMARY OF TERRAIN SITUATI



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Yog Point
1081
QUINALASAG ISLAND
656
SAN MIGUEL BAY
393
1480
Mt. Isarog 6182
Naga
Maqueda Channel
2506
211
CATANDUANES ISLAND
2330
LAGONOY
Nagumbuaya Poin
Virac Point
1630
392
Mt. Malinao 5079
GULF
Lake Bato
1690
Mayon Volcano 7943
BATAN ISLAND
RAPURAPU ISLAND
1730
ALBAY GULF
BICOL PENINSULA
Legaspi
3606
Bingay Point
Sorsogon
855
Sorsogon Bay
Railroa
(all nar
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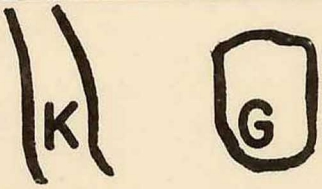
SAMAR AND LEYTE (P.I.)

10 20 30 40 50 Statute Miles

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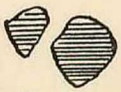


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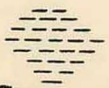


Map units referred to in accompanying text and table.

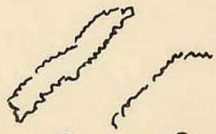
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Lakes



Swamps



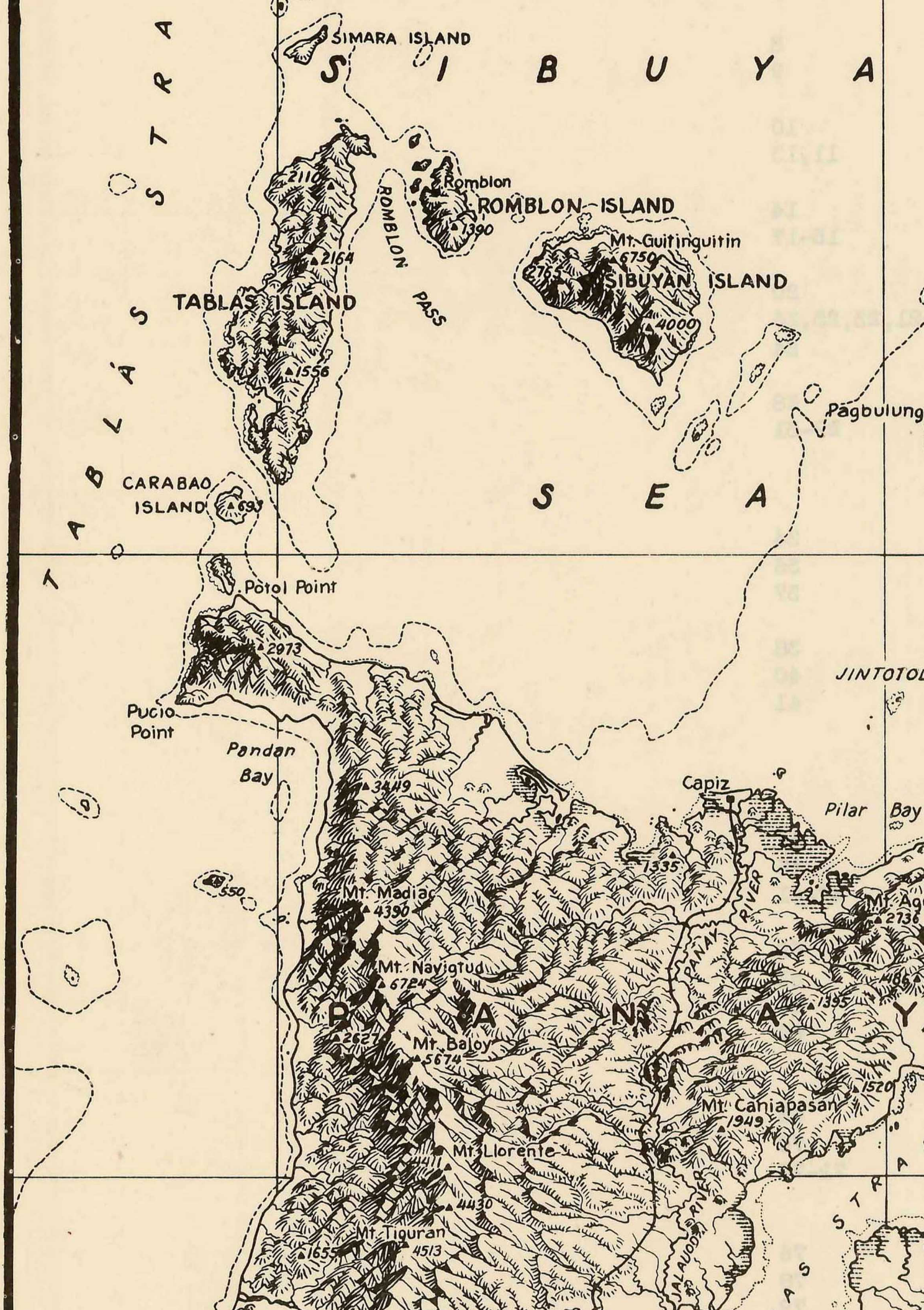
Coral reefs (some sand banks included)

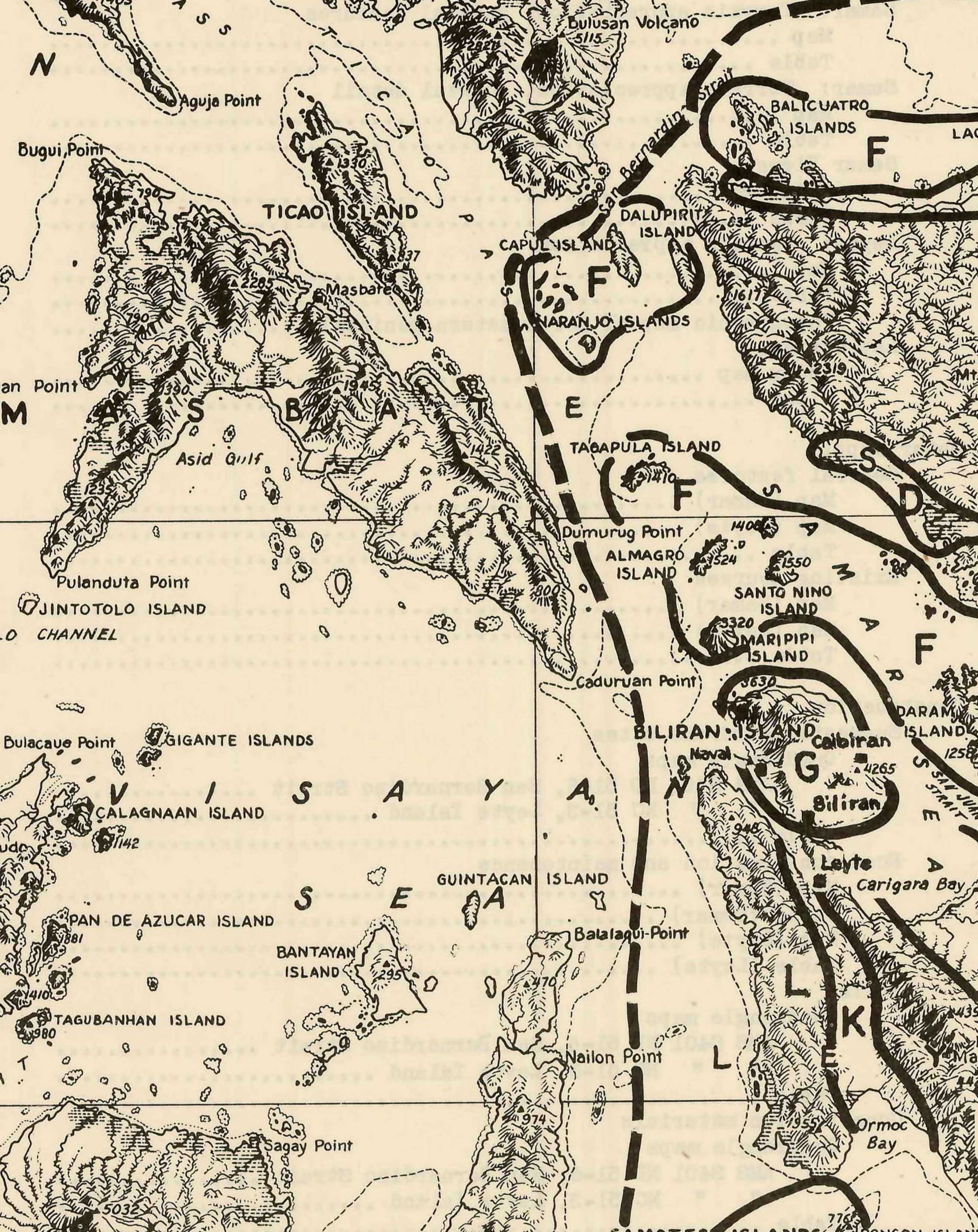
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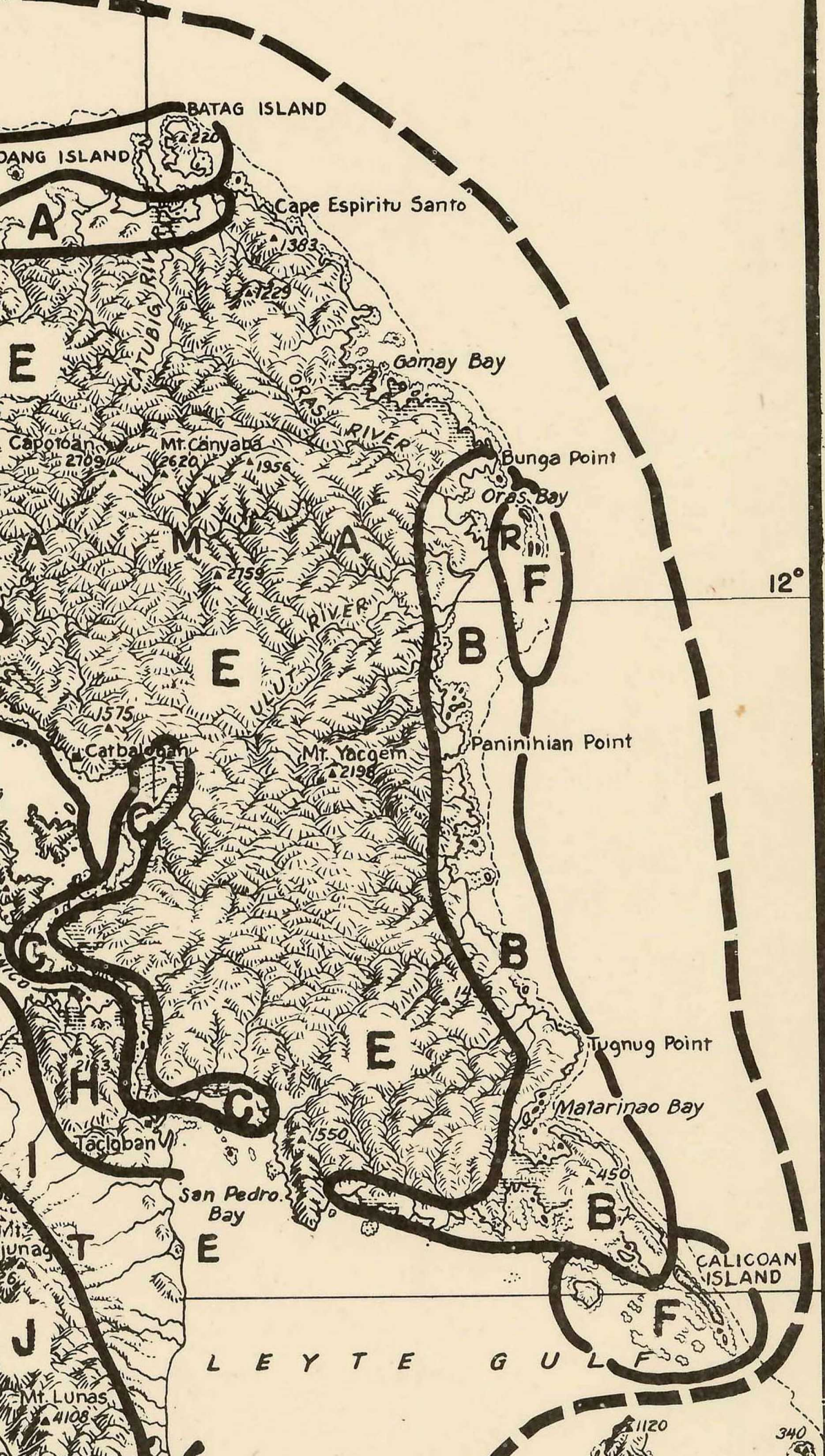


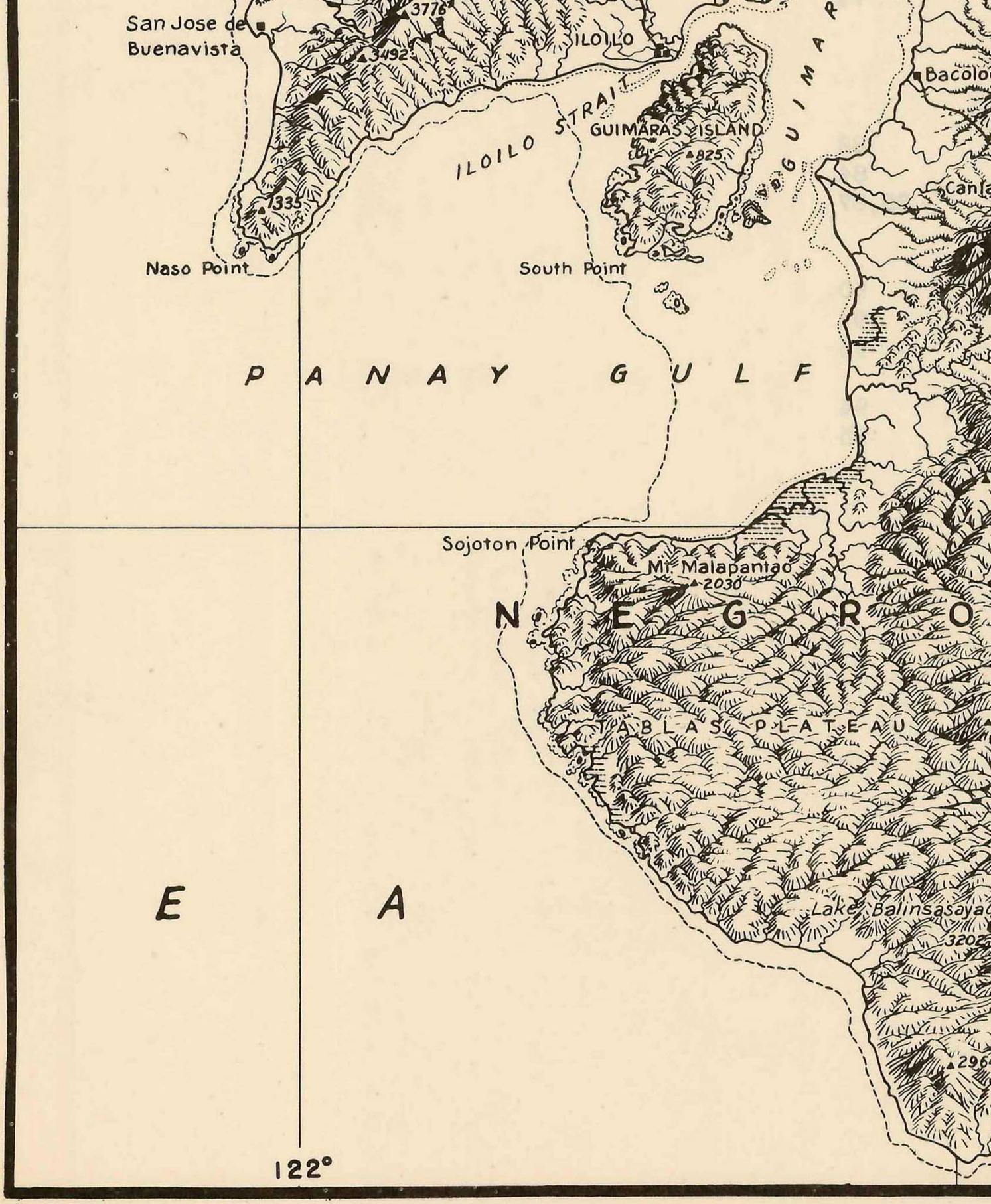
100 fathom submarine contour.

diagram drawn on map base, A.M.S. 5301, Sheets NC 51, 1:1,000,000. Details sketched from U.S. Coast and Survey Charts, 1:100,000 to 1:200,000; Philippine d Geodetic Survey maps 7, 8, 11-17, 1:200,000; and logic and topographic maps of National Development various scales. Altitudes in feet above sea level. of hills and ridges are offset about 1/10 inch north- each 3000 feet of altitude above sea level to give ession of relief. Horizontal distances can be scaled ween points of equal altitude.


SIMARA ISLAND
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TABLAS STRAIT
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Romblon
ROMBLON ISLAND
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ROMBLON PASS
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TABLAS ISLAND
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Pagbulung
CARABAO ISLAND
693
SEA
Potol Point
2973
JINTOTOL
Pucio Point
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3449
Capiz
Pilar Bay
1335
550
Mt. Madiac
4390
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Mt. Tiguran
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JALAUD RIVER

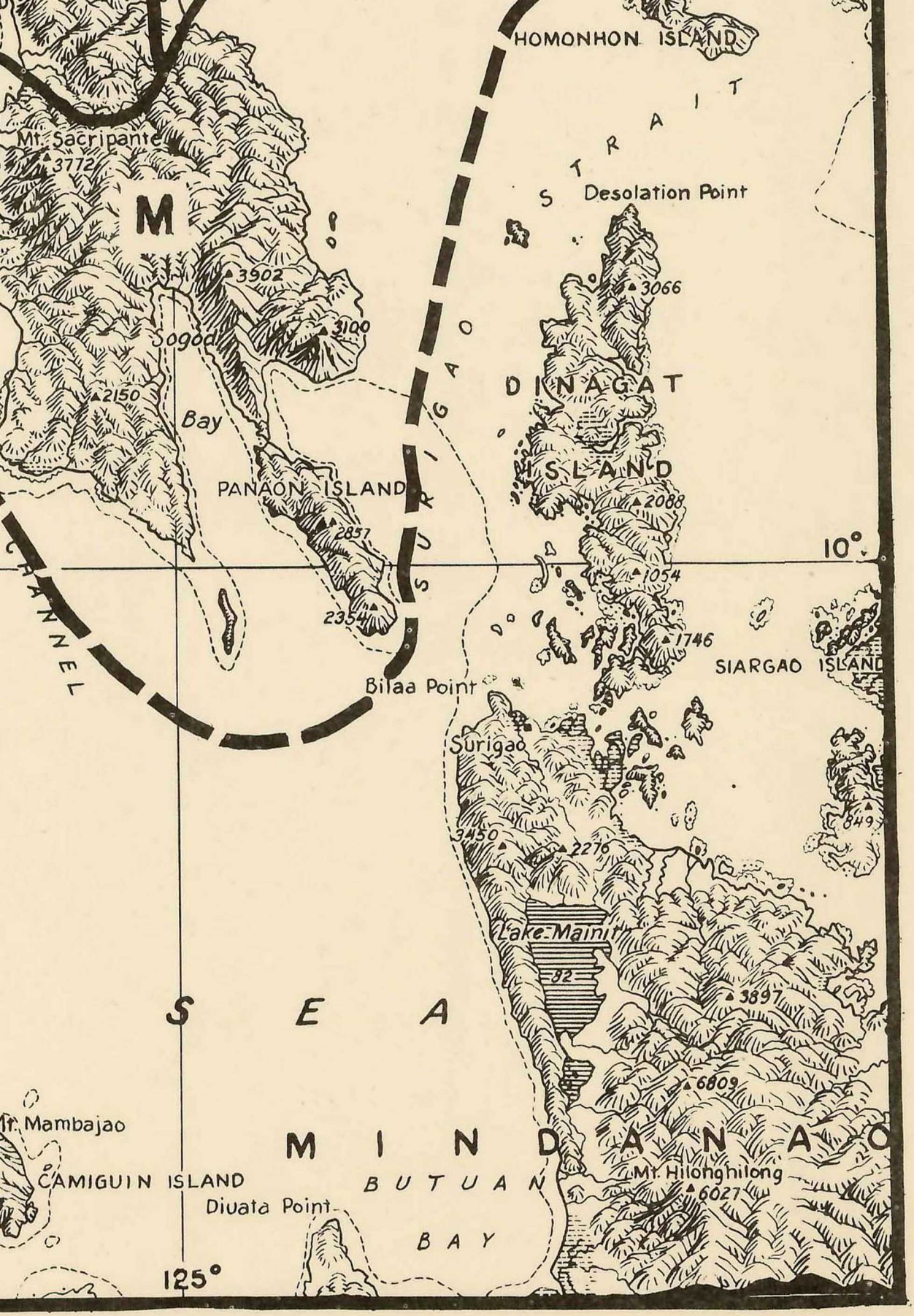

Bulusan Volcano
5115
Aguja Point
Bugui Point
TICAO ISLAND
Masbate
Asid Gulf
Pulanduta Point
JINTOTOLO ISLAND
CHANNEL
San Bernardino Strait
BALICUATRO ISLANDS
DALUPIRIT ISLAND
CAPUL ISLAND
NARANJO ISLANDS
TAGAPULA ISLAND
Dumurug Point
ALMAGRO ISLAND
SANTO NINO ISLAND
MARIPIPI ISLAND
Caduruan Point
BILIRAN ISLAND
Naval
Caibiran
Biliran
DARAM ISLAND
SAN JUAN STRAIT
Leyte
Carigara Bay
Ormoc Bay
Nailon Point
Balalaqui-Point
GUINTACAN ISLAND
PAN DE AZUCAR ISLAND
BANTAYAN ISLAND
TAGUBANHAN ISLAND
CALAGNAAN ISLAND
GIGANTE ISLANDS
Bulacaue Point
Sagay Point
VISAYAN SEA
SAMAR SEA
LEYTE


BATAG ISLAND
220
DANG ISLAND
Cape Espiritu Santo
1383
1229
CATUBIG RIVER
Gomay Bay
ORAS RIVER
Capotoan
2709
Mt. Canyaba
2620
1956
Bunga Point
Oras Bay
2159
12°
ULUT RIVER
1575
Catbalogan
Mt. Yacgem
2198
Paninihian Point
Tugnug Point
Matarinao Bay
1550
450
Tacloban
San Pedro Bay
CALICOAN ISLAND
LEYTE GULF
Mt. Lunas
4108
1120
340
A
B
C
E
F
H
J
M
R
T


San Jose de Buenavista
3776
3492
ILOILO
ILOILO STRAIT
GUIMARAS ISLAND
825
335
Naso Point
South Point
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Mt. Malapantao
2030
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FOR
CHIEF OF ENGINEERS, U. S. ARMY

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SAMAR AND LEYTE (P.I.)

SUMMARY OF TERRAIN SITUATION

I. Introduction.

Samar and Leyte are in the central-eastern part of the Philippine Archipelago.

A. Samar Island: The third largest of the Philippine Islands, is 156 miles long and 56 miles in maximum width. The total population of Samar is 548,306 (1939 census), and is mostly concentrated along the coast. Only four towns exceed 3,000 in population. Catbalogan (8,159 population) is the provincial capital. Leyte and Samar are separated by San Juanico Strait, which is only a quarter to half a mile wide but navigable for vessels of 20-foot draft.

B. Leyte Island: Situated between Cebu and Samar, is the eighth largest of the Philippine Islands. It is 120 miles long and 53 miles in maximum width. The total population, including Biliran and Panaon Islands, is 915,853 (1939 census); population is generally sparse except on the larger coastal plains. Tacloban, the provincial capital, has a population of 31,233. Only four other towns have populations of more than 5,000.

C. Climate: Rainfall occurs throughout the year, with no pronounced dry season but with maximum precipitation in winter. The annual average ranges from 66 to 166 inches in different portions of the islands. Occasional destructive typhoons pass over parts of the area, most commonly in the fall.

D. Vegetation: Forests cover most of Samar and the mountainous portions of Leyte. Agricultural land is largely restricted to the coastal region. Mangrove and nipa swamps fringe parts of both islands.

II. Terrain Appreciation.

A. Samar and Outlying Islands.

1. Coastal Lowlands (Map Units A, B, C, D).

a. Topography: Coastal plains commonly less than half a mile to five miles wide. Plain on north coast (Unit A) most extensive, backed by low hills. South and southeast coastal plain (Unit B) typically narrower, locally interrupted by low hills and rocky headlands. Western plain (Units C and D) usually narrow, although in places several miles wide, locally interrupted by headlands.

b. Movement: Roads along most coastal lowlands. Cross-country movement generally easy, but locally restricted by swamps, rice fields, and by non-fordable rivers.

2. Interior Highlands (Map Unit E).

a. Topography: Hilly to mountainous. Mostly below 2,000 feet altitude, with few prominent peaks, but typically very rugged. Many narrow, steep-sided valleys, separated by sharp ridges. Lowland belts along lower parts of main rivers.

b. Movement: Few existing roads. Foot trails in many areas. Cross-country movement generally very difficult because of steep slopes and dense forest. Movement easier along wider parts of river valleys. Several larger rivers are navigable by boats of 4- to 10-foot draft for 10 to 20 miles from coast.

3. Outlying Islands (Map Unit F).

a. Topography: Some islands, such as Daram, Naranjo, Tagapula, and Almagro, are almost entirely hilly to mountainous. Others are partly hilly, partly low, such as Calicoan and Baliconstro Islands; others are low (as the islands southeast of Cras Bay).

b. Movement: Short road on Dalupirit Island; only poor trails elsewhere Cross-country movement difficult in hilly areas; easy in lowland areas, although locally restricted by swamps.

B. Leyte and Outlying Islands.

1. Biliran Island (Map Unit G).

a. Topography: Very rough and mountainous except for wide lowlands around the towns of Caibiran, Biliran, and Naval and for narrow flats along other parts of the coast.

b. Movement: Free movement restricted to the wide lowlands. Remainder of area impassable for motorized units. Trails around margin of island and across the interior cannot be used by motorized equipment without considerable improvement and construction.

2. Mountains of Northern Leyte (Map Units H, J, L).

a. Topography: Three rough mountainous areas divided by lowlands:

(1) Hills and low mountains in northeast Leyte (Unit H).

(2) High range of rugged volcanic peaks across central Leyte, merging with mountains of southern part (Unit J).

(3) Northwest peninsula (Unit L), rough and hilly with steepest slopes and greatest elevations in southern part.

b. Movement: Mountainous areas are barriers.

(1) Principal roads skirt mountains of northeast Leyte (Unit H); only poor foot trails into upland.

(2) Two roads provide only routes for motorized units across central range (Unit J); some improvement needed for all-weather use. A few good foot trails.

(3) Road for light traffic crosses hills of northwest peninsula (Unit L). Northern end permits some free movement. Central and southern parts unsuitable except for foot troops.

3. Lowlands of Northern Leyte (Map Units I and K).

a. Topography:

(1) Northeastern lowland (Unit I), between northeastern and central mountains.

(2) Leyte-Ormoc Bay corridor (Unit K), broad plains near coast, rising inland to low hilly divide.

b. Movement: Numerous good motor roads on northeast lowland of Leyte; connect principal towns. Road across Leyte-Ormoc Bay corridor. Movement in lowlands restricted only locally by swamps and wet low ground, by hilly divide in Leyte-Ormoc Bay corridor, and by deep ravines in higher parts of plains near mountains.

4. Southern Leyte (Map Unit M).

(a) Topography: Southern Leyte and Panaon Island predominantly mountainous with steep-sided ridges and crooked, narrow valleys. Lowlands include a narrow continuous flat along most of west coast and discontinuous, small, coastal plains around Sogod Bay and on east coast.

(b) Movement: Road along coast requires some improvement for all-weather use of military traffic. Two good trails across interior for foot troops. Small coastal lowlands permit restricted movement away from roads. Remainder of area is impassable for vehicles away from roads; movement difficult even for foot troops.

5. Camotes Islands (Map Unit N)

(a) Topography: Three islands with central hilly areas bordered by belts of flat land.

(b) Movement: Short roads on all islands. Movement is fairly easy except in steepest parts of hills.

III. Water Supply.

A. Existing Supplies: Water supplies abundant in most parts of Samar, Leyte, and Biliran Islands. Numerous perennial streams and springs; shallow dug wells at many settlements; a few artesian wells. On smaller islands, few or no perennial streams or springs, but shallow wells at most settlements. Because of endemic anebic dysentery, water from streams and shallow wells should be heavily treated with halazone, or preferably, should be passed through diatomaceous earth filters and treated with halazone.

B. Combat and Temporary Camp Supplies: Recommended sources are artesian wells, springs, shallow wells, or streams, in order named.

C. Semipermanent and Permanent Bases: Supplies should be obtained from wells, if possible. Abundant supplies not requiring filtering or extensive treatment can be obtained from depths of less than 50 feet in many parts of the larger islands.

IV. Airdrome Construction.

A. Suggested Airdrome Sites:

(1) Pre-1941 airfields that can be expanded are located at Catarman and Calbayog on Samar, and at Tacloban on Leyte.

(2) The northeast lowland (Area I) on Leyte Island provides ample space for many airdromes with 6,000-foot runways. Seven enemy fields reported in eastern part of this area.

(3) Numerous feasible sites for one or more 6,000-foot runways are found on coastal plains around both Samar and Leyte; particularly numerous on north and east coasts of Samar, and on west coast of Leyte (south and central parts). Several good sites on raised coral terraces on the Camotes Islands, and on deltaic flats on Biliran Island.

B. Major Construction Problems:

(1) Drainage and stabilization of subgrades, particularly on the clayey and silty soil of northeast lowland on Leyte Island and inner parts of coastal plains. Most areas subject to periodic flooding by torrential rains and stream overflow.

(2) Grading generally light on the northeast lowland and on coastal plains; moderate on raised coral reefs, such as sites on Camotes Islands.

(3) Clearing of coconut palm groves and secondary forest.

(4) Supply of construction materials for many coastal plain sites.

V. Road Construction Problems.

A. Existing Roads:

(1) Samar Island: Alternating first- and second-class roads along most of north and west coasts, central part of east coast. First-class road connects west and north coasts; first- and second-class road from east to west coast.

(2) Leyte Island: First class all-weather roads on northeastern plain and along southwestern coast; second-class roads along most of southern coast and parts of southeastern and northern coasts. First-class road connects eastern and western coasts; first- and second-class road from western to northern coasts.

B. Ease of Constructing Additional Roads:

(1) Samar Island: Construction of coastal roads relatively easy except east side of San Pedro Bay, north ends of east and west coasts; numerous rocky headlands to cross. Construction in mountains difficult except along lower parts of few large river valleys.

(2) Leyte Island: Construction in northeast coastal plain and along most of coast relatively easy; construction in mountains difficult.

(3) Existing roads of all classes (including proposed roads) and coastal trails have good alignments and grades; probably can be used for locations with minimum construction. Mountain trails have many steep grades, difficult alignments for roads.

C. Major Construction Problems:

(1) Slides on mountain roads; require extensive grading and clearing.

(2) Natural soils on all roads commonly poor for subgrades.

(3) Rainfall throughout year interferes with completion of foundations, subgrades; causes erosion of cuts and fills; makes drainage difficult.

(4) Stream crossings difficult. Main streams generally wide, deep, cannot be forded near coast. Occasional large flash floods, particularly in winter.

VI. Construction Materials.

A. Sand and Gravel: Occur along most streams in and near mountainous areas and on beaches.

B. Coral Reefs: Good all-purpose construction material, widespread along coasts.

C. Limestone and Trap Rock: Excellent for most construction uses, obtainable in many mountainous localities on Leyte; much less widespread on Samar.

D. Asphaltic Sandstone: Excellent road surfacing material. Small deposits in northwest Leyte.

E. Timber: Heavy timber for construction use abundant on mountainous areas in the larger islands.

SUMMARY OF THE TERRAIN SITUATION

- Favorable for military operations in nearly all parts.
- Mostly favorable for military operations; unfavorable in some parts.
- Mostly unfavorable for military operations; favorable in some parts.
- Unfavorable for military operations in nearly all parts.

SAMAR

Number and Name of Area	Suitability of Terrain for Vehicular Movement: Topography	Vegetation	Stream Crossings	Roads: Existing Roads	Roads: Suitability for Road Construction	Suitability for Airdrome Construction	Water Supply: Surface Water	Water Supply: Under Ground Water	Construction Materials
A North Coast									
B East and Southeast Coast									
C Southwest Coast									
D Central West Coast									
E Hills and Mountains									
F Outlying Islands									

LEYTE

G Biliran Island									
H Northeast Mountains and Coast									
I Northeast Lowlands									
J Central Highland									
K Ormoc-Leyte Bay-Corridor									
L Northwest Peninsula									
M Southern Leyte									
N Camotes Islands									

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

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SAMAR AND LEYTE (P.I.)

I. Introduction.

Samar and Leyte are in the central-eastern part of the Philippine Ar

A. Samar Island: The third largest of the Philippine Islands, is l long and 58 miles in maximum width. The total population of Sam 546,306 (1939 census), and is mostly concentrated along the coas four towns exceed 3,000 in population. Catbalogan (8,159 popula provincial capital. Leyte and Samar are separated by San Juanic which is only a quarter to half a mile wide but navigable for ve 20-foot draft.

B. Leyte Island: Situated between Cebu and Samar, is the eighth la Philippine Islands. It is 120 miles long and 53 miles in maximu The total population, including Biliran and Panaon Islands, is (1939 census); population is generally sparse except on the larg plains. Tacloban, the provincial capital, has a population of four other towns have populations of more than 5,000.

C. Climate: Rainfall occurs throughout the year, with no pronounce but with maximum precipitation in winter. The annual average r 85 to 165 inches in different portions of the islands. Occasio tive typhoons pass over parts of the area, most commonly in the

D. Vegetation: Forests cover most of Samar and the mountainous po Leyte. Agricultural land is largely restricted to the coastal grove and nipa swamps fringe parts of both islands.

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4. Southern Leyte (Map Unit M).

(a) Topography: Southern Leyte and Panaon Island predominantly mountainous with steep-sided ridges and crooked, narrow valleys. Lowlands include a narrow continuous flat along most of west coast and discontinuous, small, coastal plains around Sogod Bay and on east coast.

(b) Movement: Road along coast requires some improvement for all-weather use of military traffic. Two good trails across interior for foot troops. Small coastal lowlands permit restricted movement away from roads. Remainder of area is impassable for vehicles away from roads; movement difficult even for foot troops.

5. Camotes Islands (Map Unit N)

(a) Topography: Three islands with central hilly areas bordered by belts of flat land.

(b) Movement: Short roads on all islands. Movement is fairly easy except in steepest parts of hills.

III. Water Supply.

SUMMARY OF TERRAIN SITUATION

VI. Construction Materials.

A. Sand and Gravel: Occur along most streams in and near mountainous areas and on beaches.

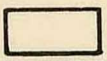
B. Coral Reefs: Good all-purpose construction material, widespread along coasts.

C. Limestone and Trap Rock: Excellent for most construction uses, obtainable in many mountainous localities on Leyte; much less widespread on Samar.

D. Asphaltic Sandstone: Excellent road surfacing material. Small deposits in northwest Leyte.

E. Timber: Heavy timber for construction use abundant on mountainous areas in the larger islands.

SUMMARY OF THE TERRAIN SITUATION



Favorable for military operations in nearly all parts.



Mostly favorable for military operations; unfavorable in some parts.

II. Terrain Appreciation.

A. Samar and Outlying Islands.

1. Coastal Lowlands (Map Units A, B, C, D).

a. Topography: Coastal plains commonly less than half a mil to five miles wide. Plain on north coast (Unit A) most e backed by low hills. South and southeast coastal plain (typically narrower, locally interrupted by low hills and lands. Western plain (Units C and D) usually narrow, alt places several miles wide, locally interrupted by headlan

b. Movement: Roads along most coastal lowlands. Cross-cour generally easy, but locally restricted by swamps, rice fi non-fordable rivers.

2. Interior Highlands (Map Unit E).

a. Topography: Hilly to mountainous. Mostly below 2,000 fe with few prominent peaks, but typically very rugged. Mar steep-sided valleys, separated by sharp ridges. Lowland lower parts of main rivers.

b. Movement: Few existing roads. Foot trails in many areas country movement generally very difficult because of ste dense forest. Movement easier along wider parts of rive Several larger rivers are navigable by boats of 4- to 10- for 10 to 20 miles from coast.

3. Outlying Islands (Map Unit F).

a. Topography: Some islands, such as Daram, Naranjo, Tagap Almagro, are almost entirely hilly to mountainous. Othe hilly, partly low, such as Calicoan and Balicuatro Islan are low (as the islands southeast of Oras Bay).

b. Movement: Short road on Dalupirit Island; only poor tra Cross-country movement difficult in hilly areas; easy in areas, although locally restricted by swamps.

B. Leyte and Outlying Islands.

1. Biliran Island (Map Unit G).

a. Topography: Very rough and mountainous except for wide around the towns of Caibiran, Biliran, and Naval and for along other parts of the coast.

b. Movement: Free movement restricted to the wide lowlands of area impassable for motorized units. Trails around m island and across the interior cannot be used by motoriz without considerable improvement and construction.

2. Mountains of Northern Leyte (Map Units H, J, L).

a. Topography: Three rough mountainous areas divided by lo

(1) Hills and low mountains in northeast Leyte (Unit

(2) High range of rugged volcanic peaks across centr merging with mountains of southern part (Unit J)

(3) Northwest peninsula (Unit L), rough and hilly wit slopes and greatest elevations in southern part.

b. Movement: Mountainous areas are barriers.

(1) Principal roads skirt mountains of northeast Ley only poor foot trails into upland.

A. Existing Supplies: Water supplies abundant in most parts of Samar, Leyte, and Biliran Islands. Numerous perennial streams and springs; shallow dug wells at many settlements; a few artesian wells. On smaller islands, few or no perennial streams or springs, but shallow wells at most settlements. Because of endemic amebic dysentery, water from streams and shallow wells should be heavily treated with halazone, or preferably, should be passed through diatomaceous earth filters and treated with halazone.

B. Combat and Temporary Camp Supplies: Recommended sources are artesian wells, springs, shallow wells, or streams, in order named.

C. Semipermanent and Permanent Bases: Supplies should be obtained from wells, if possible. Abundant supplies not requiring filtering or extensive treatment can be obtained from depths of less than 50 feet in many parts of the larger islands.

IV. Airdrome Construction.

A. Suggested Airdrome Sites:

(1) Pre-1941 airfields that can be expanded are located at Catarman and Calbayog on Samar, and at Tacloban on Leyte.

(2) The northeast lowland (Area I) on Leyte Island provides ample space for many airdromes with 6,000-foot runways. Seven enemy fields reported in eastern part of this area.

(3) Numerous feasible sites for one or more 6,000-foot runways are found on coastal plains around both Samar and Leyte; particularly numerous on north and east coasts of Samar, and on west coast of Leyte (south and central parts). Several good sites on raised coral terraces on the Camotes Islands, and on deltaic flats on Biliran Island.

B. Major Construction Problems:

(1) Drainage and stabilization of subgrades, particularly on the clayey and silty soil of northeast lowland on Leyte Island and inner parts of coastal plains. Most areas subject to periodic flooding by torrential rains and stream overflow.

(2) Grading; generally light on the northeast lowland and on coastal plains; moderate on raised coral reefs, such as sites on Camotes Islands.

(3) Clearing of coconut palm groves and secondary forest.

(4) Supply of construction materials for many coastal plain sites.

V. Road Construction Problems.

A. Existing Roads:

(1) Samar Island: Alternating first- and second-class roads along most of north and west coasts, central part of east coast. First-class road connects west and north coasts; first- and second-class road from east to west coast.

(2) Leyte Island: First class all-weather roads on northeastern plain and along southwestern coast; second-class roads along most of southern coast and parts of southeastern and northern coasts. First-class road connects eastern and western coasts; first- and second-class road from western to northern coasts.

B. Ease of Constructing Additional Roads:

(1) Samar Island: Construction of coastal roads relatively easy except east side of San Pedro Bay, north ends of east and west coasts; numerous rocky headlands to cross. Construction in mountains difficult except along lower parts of few large river valleys.

Mostly unfavorable for military operations; favorable in some parts.

Unfavorable for military operations in nearly all parts.

SAMAR

Number and Name of Area	Suitability of Terrain for Vehicular Movement			Roads		Suitability for Airdrome Construction	Water Supply		Construction Materials
	Topography	Vegetation	Stream Crossings	Existing Roads	Suitability for Road Construction		Surface Water	Under Ground Water	
A North Coast									
B East and Southeast Coast									
C Southwest Coast									
D Central West Coast									
E Hills and Mountains									
F Outlying Islands									

LEYTE

G Biliran Island									
H Northeast Mountains and Coast									
I Northeast Lowlands									
J Central Highland									
K Ormoc-Leyte Bay-Corridor									
L Northwest Peninsula									
M Southern Leyte									
N Camotes Islands									

(2) Two roads provide only routes for motorized unit
central range (Unit J); some improvement needed
weather use. A few good foot trails.

(3) Road for light traffic crosses hills of northwes
(Unit L). Northern and permits some free moveme
and southern parts unsuitable except for foot tr

3. Lowlands of Northern Leyte (Map Units I and K).

a. Topography:

(1) Northeastern lowland (Unit I), between northeaste
central mountains.

(2) Leyte-Ormoc Bay corridor (Unit K), broad plains
rising inland to low hilly divide.

b. Movement: Numerous good motor roads on northeast lowla
connect principal towns. Road across Leyte-Ormoc Bay c
Movement in lowlands restricted only locally by swamps
ground, by hilly divide in Leyte-Ormoc Bay corridor, ar
ravines in higher parts of plains near mountains.

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(2) Leyte Island: Construction in northeast coastal plain and along most of coast relatively easy; construction in mountains difficult.

(3) Existing roads of all classes (including proposed roads) and coastal trails have good alignments and grades; probably can be used for locations with minimum construction. Mountain trails have many steep grades, difficult alignments for roads.

C. Major Construction Problems:

(1) Slides on mountain roads; require extensive grading and clearing.

(2) Natural soils on all roads commonly poor for subgrades.

(3) Rainfall throughout year interferes with compaction of foundations, subgrades; causes erosion of cuts and fills; makes drainage difficult.

(4) Stream crossings difficult. Main streams generally wide, deep, cannot be forded near coast. Occasional large flash floods, particularly in winter.

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FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE (P.I.)

INTRODUCTION

This report was prepared by the Geological Survey, United States Department of the Interior, for the Chief of Engineers, U. S. Army, during the months of July and August, 1944. It describes those terrain features of Samar, Leyte and some neighboring islands that are of military significance. Each map, and its accompanying table, is devoted to a specialized set of problems; together they present a broad regional picture of the character of the country, including the relationship of terrain to movement, airdrome sites, road construction and maintenance problems, water supply, and nature and location of principal types of construction materials, geology, and soils. Climate and vegetation are considered briefly; other intelligence reports should be consulted for detailed information.

RELIABILITY OF INFORMATION

Large parts of the interior of Samar and the mountainous parts of Leyte are little known, and many areas are still unexplored. The completeness and reliability of information differs widely for different parts of the islands. Reliability ratings given the sheets of this folio range from good to poor. On certain sheets different parts have been given different ratings.

The coastal parts of the islands are the best known and are covered by U. S. Coast and Geodetic Survey charts (1:100,000 scale). Supplementary topographic information has been gained from unpublished military maps of a few small areas, various aerial photos and ground views, and travelers' accounts. The topography shown by hachures. Coast and Geodetic Survey (Department of National Defense, Manila, P. I.) Quadrangles 13 (Samar) and 14 (Letye) is generally unreliable, even along the coasts, although spot altitudes are probably accurate.

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Willis, Bailey, Geologic observations in the Philippine Archipelago: Nat. Res. Coun. Phil. Is., Bull. 13, pp. 1-54, pls. 1-29, 1937. Discusses major faults in Leyte in relation to general structure of Philippines.

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Dorsey, Clarence W., Soil conditions in the Philippines: 7th Ann. Rept. Philippine Commission, 1906, pt. 3, pp. 368-369, 377-378, Washington, 1907. Brief statement of soil conditions on Leyte and Samar.

Water Supply:

Cox, Alvin J., Heise, George W., Gara, V. Q., Water supplies in the Philippine Islands: Phil. Jour. Sci., ser. A, vol. 9, no. 4, pp. 273-411, Manila, 1914. Contains several analyses of river, spring, and well water used for domestic purposes on Leyte and Samar.

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Samar, no. 13, 1:200,000, 1940.
Philippine Aeronautical Chart no. 2, Southern Luzon and Northern Visayas, 1939.

U. S. Coast and Geodetic Survey:
Charts 4220, 4405, 4420-4427, 4449, 4456, 4467.

Military map of portion of Samar, 1:63,360, 2 sheets and other unpublished maps.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

INTRODUCTION

This report was prepared by the Geological Survey, United States Department of the Interior, for the Chief of Engineers, U. S. Army, during the months of July and August, 1944. It describes those terrain features of Samar, Leyte and some neighboring islands that are of military significance. Each map, and its accompanying table, is devoted to a specialized set of problems; together they present a broad regional picture of the character of the country, including the relationship of terrain to movement, airdrome sites, road construction and maintenance problems, water supply, and nature and location of principal types of construction materials, geology, and soils. Climate and vegetation are considered briefly; other intelligence reports should be consulted for detailed information.

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General (cont.)

List of rivers of the Philippine Islands, with information as to location, navigability, shelter afforded and adjacent population. Compiled by Div. Port Works, Bur. Navigation, Dept. Comm. and Police, Philippine Islands, 114 pp., Manila, 1912. Contains brief statements about principal rivers of Samar and Leyte.

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Water

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SAMAR AND LEYTE (P.I.)

Supply (cont.)

ublic Works Bull., vol. 9-19, Manila, 1921-1931.
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ighways, bridges.

e-water supply of the Philippine Islands 1908-1922:
ur. Public Works, Dept. Comm. and Comm., Water-
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rom 9 localities in Leyte; volume 4 contains a few
iscellaneous discharge records and rainfall records,
ll on Leyte.

igence Reports:

ering Research Office, Spec. Rept. no. 75,
hilippines, 1943.

RELIABILITY OF INFORMATION

Large parts of the interior of Samar and the mountainous parts of Leyte are little known, and many areas are still unexplored. The completeness and reliability of information differs widely for different parts of the islands. Reliability ratings given the sheets of this folio range from good to poor. On certain sheets different parts have been given different ratings.

The coastal parts of the islands are the best known and are covered by U. S. Coast and Geodetic Survey charts (1:100,000 scale). Supplementary topographic information has been gained from unpublished military maps of a few small areas, various aerial photos and ground views, and travelers' accounts. The topography shown by hachures. Coast and Geodetic Survey (Department of National Defense, Manila, P. I.) Quadrangles 13 (Samar) and 14 (Letye) is generally unreliable, even along the coasts, although spot altitudes are probably accurate.

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Willis, Bailey, Geologic observations in the Philippine Archipelago: Nat. Res. Coun. Phil. Is., Bull. 13, pp. 1-54, pls. 1-29, 1937. Discusses major faults in Leyte in relation to general structure of Philip-

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Maps:

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Intelligence Command of Pacific Operations Report.

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nd other unpublished maps.

Census of the Philippines, 1939: Census Atlas of the Philippines, vol. 5, Manila, 1941. Maps showing geography, density of population, climate, resources.

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pines.

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Heise, George W., and Behrman, A. A., Philippine water supplies: Phil. Is. Bur. Sci., Manila, 1918.

CONFIDENTIAL

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.


TERRAIN DIAGRAM
SAMAR AND LEYTE (P.I.)
EXPLANATION
Railroads (all narrow gauge, 3' 6")
Lakes
Swamps
Coral reefs (some sand banks included)
Sand banks and submerged mud flats
100 fathom submarine contour
Terrain diagram drawn on map base, A.M.S. 5301, Sheets NC 51, NC 51, and NE 51, 1:1,000,000. Details sketched from U.S. Coast and Geodetic Survey Charts, 1:150,000 to 1:200,000; Philippine Coast and Geodetic Survey maps 3-17, 1:200,000; Military Survey of Luzon, A. M. S. 5711, 1:50,360; and from geologic and topographic maps of National Development Company, various scales. Altitudes in feet above sea level. Summits of hills and ridges are offset about 1/10 inch northward for each 3000 feet of altitude above sea level to give the impression of relief. Horizontal distances can be scaled only between points of equal altitude.
10 0 10 20 30 40 50 Statute Miles
10 0 10 20 30 40 50 60 70 Kilometers
CHINA SEA
PACIFIC OCEAN
SULU SEA
MINDANAO SEA
LUZON
MINDORO
PALAWAN
(Eastern Extremity)
SAMAR
LEYTE
BABUYAN CHANNEL
LINGAYEN GULF
MANILA BAY
LAMON BAY
POLILLO ISLANDS
POLILLO STRAIT
LUBANG ISLANDS
VERDE ISLAND PASSAGE
MARINDUQUE ISLAND
TAYABAS BAY
RAGAY GULF
LAGONOY GULF
SAN MIGUEL BAY
MINDORO STRAIT
SIBUYAN SEA
TICAO ISLAND
BURIAS ISLAND
MASBATE ISLAND
SAMAR SEA
LEYTE GULF
CAMOTES ISLANDS
CAMOTES SEA
CUYO ISLANDS
PANAY GULF
SURIGAO STRAIT
BOHOL SEA
SIBUTU PASSAGE
SULU SEA
MINDANAO SEA
BUTUAN BAY
Cape Bojeador
Cape Engaño
Palaui Island
Camiguin Island
Fuga Island
Mayraira Pt.
Divilacan Bay
Casiguran Bay
Dingalan Bay
Baler Bay
Lingayen Gulf
Agno River
Agno Delta
Cape Bolinao
Cape Santiago
Cape Cabarruyan
Cape Calavite
Puerto Galera
Batangas Bay
Balayan Bay
Tayabas Bay
Lamon Bay
Ragay Gulf
Lagonoy Gulf
San Miguel Bay
Sibuyan Sea
Tablas Island
Romblon Island
Carabao Island
Semirara Island
Semirara Islands
Calauit Island
Cuyo Islands
Cuyo Island
Panay Gulf
Guimaras Island
Iloilo Strait
Negros Occidental
Negros Oriental
Cagayan Islands
Siquijor Island
Bohol Sea
Camotes Islands
Camotes Sea
Leyte Gulf
Surigao Strait
Sibutu Passage
Sulu Sea
Mindanao Sea
Butuan Bay
Dinagat
Siargao
Samar Sea
Manila
Corregidor Island
Mariveles Mts.
Mt. Banahaw
Mt. Natib
Mt. Mariveles
Mt. Canlaon
Mt. Mantalingajan
Mt. Mambajao
Mt. Hibok-Hibok
Mt. Guinlalasag
Mt. Cabalian
Mt. Bulusan
Mt. Allen
Mt. Capoocan
Mt. Tigbao
Mt. Tapulao
Mt. Pulog
Mt. Data
Mt. Amuyao
Mt. Polis
Mt. Tabuan
Mt. Tagapuluan
Mt. Tandaya
Mt. Hamut
Mt. Cantil
Mt. Tinagong Dagat
Mt. Cabalian
Mt. Bulusan
Mt. Allen
Mt. Capoocan
Mt. Tigbao
Mt. Tapulao
Mt. Pulog
Mt. Data
Mt. Amuyao
Mt. Polis
Mt. Tabuan
Mt. Tagapuluan
Mt. Tandaya
Mt. Hamut
Mt. Cantil
Mt. Tinagong Dagat
PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

TERRAIN DIAGRAM




122°
123°
124°
CAMIGUIN ISLAND
303
372
CHANNEL
Cape Engaño
PALAUI ISLAND
390
Escarpada Point
1060
378
Mt. Cagua
3800
1800
1520
3267
716
181
1500
5316
Mt. Cetaceo
3114
Tuguegarao
Mt. Dos Cuernos
3771
2306
6138
Divilacan Bay
Mt. Cresta
5490
Aubarede Point
4300
Ilagan
59
Palanan Point
Mt. Palanan
4006
1055
5157
3262
Mt. Dos Hermanos
Diapitan Bay
PACIFIC
1086
6076
1660
3495
2120
Casiguran Sound
Cape San Ildefonso
Bay
10 0 10 20 30
10 0 10 20 30 40 50 60

SAMAR AND LEYTE (P.I.)

125°

126°

19°

18°

17°

16°

40 50 Statute Miles

0 70 Kilometers

EXPLANATION

Railroads (all narrow gauge, 3' 6")

Lakes

Swamps

Coral reefs (some sand banks included)

Sand banks and submerged mud flats

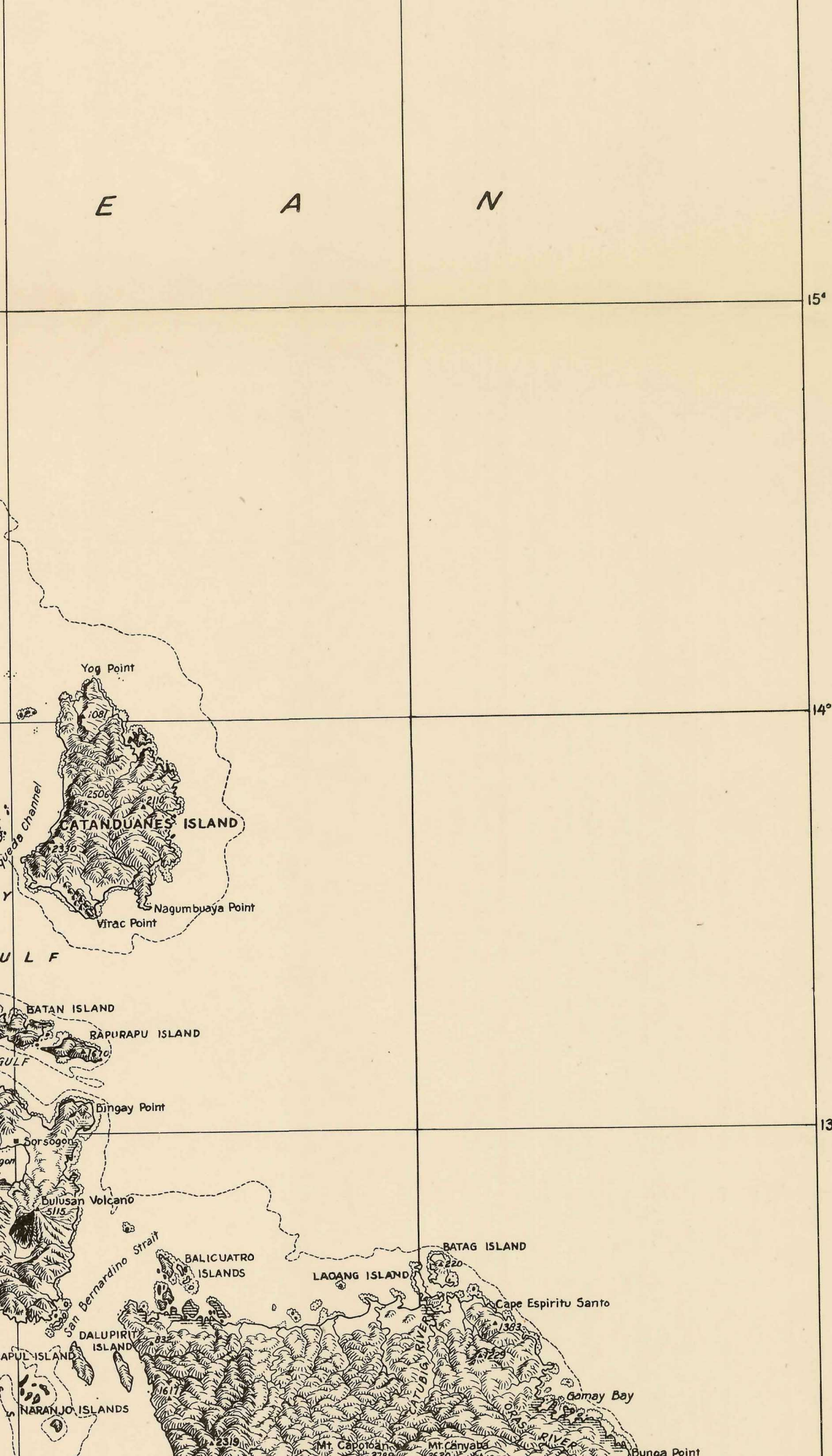
100 fathom submarine contour

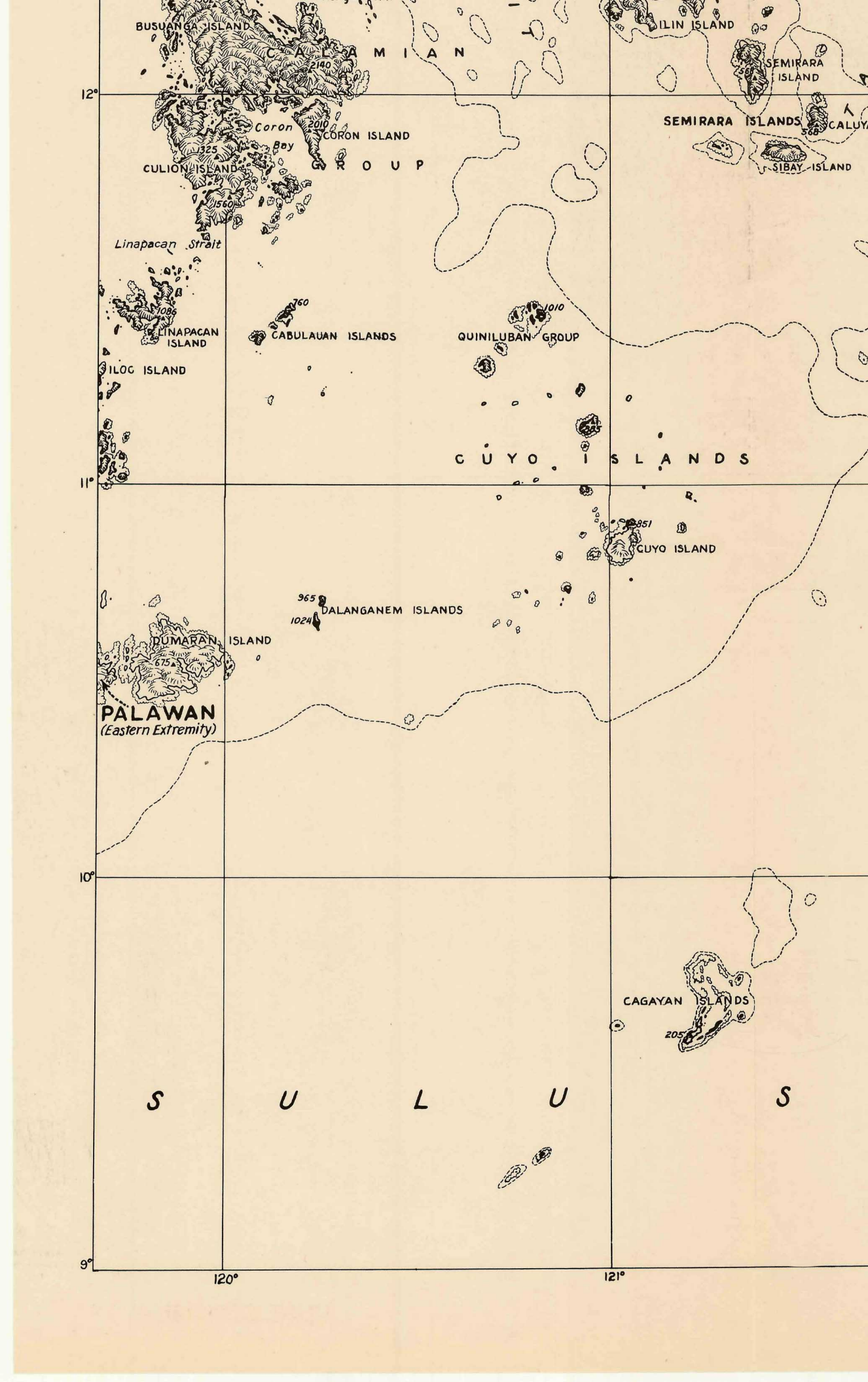
Terrain diagram drawn on map base, A.M.S. 5301, Sheets NC 51, ND 51, and NE 51, 1:1,000,000. Details sketched from U.S. Coast and Geodetic Survey Charts, 1:100,000 to 1:200,000; Philippine Coast and Geodetic Survey maps 3-17, 1:200,000; Military Survey of Luzon, A. M. S. S711, 1:63,360; and from geologic and topographic maps of National Development Company, various scales. Altitudes in feet above sea level. Summits of hills and ridges are offset about 1/10 inch northward for each 3000 feet of altitude above sea level to give the impression of relief. Horizontal distances can be scaled only between points of equal altitude.

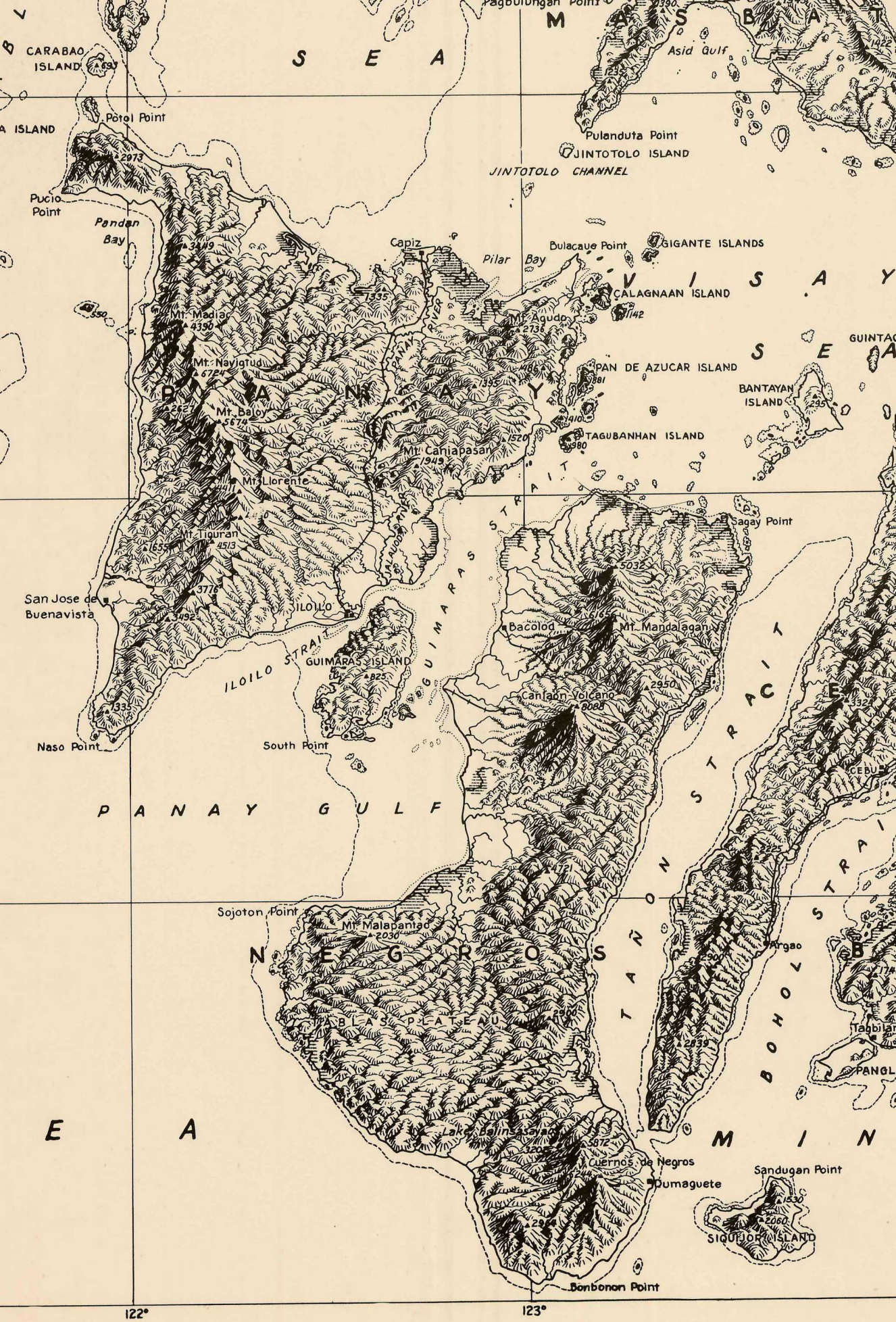
I F I C


LUZON
Tarlac
Cabanatuan
Mt Arayat
Candaba Swamp
San Fernando
Iba
Dingalan Bay
Mt. Natib
Sampaloc Point
Subic Bay
Balanga
Mariveles Mts.
Mt. Bataan
MANILA BAY
MANILA
Pasay
Pasig
Montalban
Cavite
Cochinos Point
CORREGIDOR ISLAND
Naic
LAGUNA DE BAY
Santa Cruz
Mt. Banahao
Mt. Batulao
LAKE TAAL
Elev. 8'
Elev. 7'
Lucena
CABRA ISLAND
Balayan Bay
Cape Santiago
Batangas
Bantigui Point
LUBANG ISLANDS
LUBANG ISLAND
GOLA ISLAND
MARICABAN ISLAND
VERDE ISLAND PASSAGE
VERDE ISLAND
Malabrigo Point
Mt. Calavite
Cape Calavite
Paluan Bay
Calapan
Mt. Halcon
Lake Naujan
MINDORO
MINDORO STRAIT
Mt. Baco
Dongon Point
APO ISLAND
Pandan Point
Coconongon Point
15°
14°
13°


N
O C
POLILLO ISLANDS
POLILLO
ISLAND
JALA ISLANDS
PATNANONGAN ISLAND
Burdeos Bay
OMALIG ISLAND
STRAIT
CALAGUA ISLANDS
LAMON BAY
BALESIN ISLAND
CABALETE ISLAND
Dapdap Point
ALABAT
ISLAND
Calauag Bay
Lopez Bay
Mt. Cadig
Mt. Labo
3092
Daet
QUINALASAG
ISLAND
SAN MIGUEL
BAY
Mt. Isarog
6182
Naga
COL
RIVER
LAGONO
Mt. Malinao
5079
Lake Bato
Mayon Volcano
7943
Legaspi
ALBAY
GULF
MOMPOG PASS
Boac
Mt. San Antonio
2859
3876
Bondoc Point
DOS HERMANAS ISLANDS
BURIAS ISLAND
BURIAS PASS
BANTON ISLAND
SIMARA ISLAND
SIBUYAN
Aguja Point
Bugui Point
Romblon
ROMBLON ISLAND
ROMBLON PASS
Mt. Guitinguitin
6750
SIBUYAN ISLAND
4000
TICAO ISLAND
Masbate
TABLAS ISLAND
1556


E A N
15°
14°
13°
Yog Point
1081
2506
2116
CATANDUANES ISLAND
2330
Nagumbuaya Point
Virac Point
Yueda Channel
U L F
BATAN ISLAND
RAPURAPU ISLAND
GULF
Bingay Point
Sorsogon
Bulusan Volcano
5115
San Bernardino Strait
BALICUATRO ISLANDS
LAOANG ISLAND
BATAG ISLAND
220
Cape Espiritu Santo
1383
1229
DALUPIRIT ISLAND
832
APUL ISLAND
1611
NARANJO ISLANDS
2319
Mt. Capotoan
Mt. Cányaba
TUBIG RIVER
ORAS RIVER
Gamay Bay
Bungsa Point

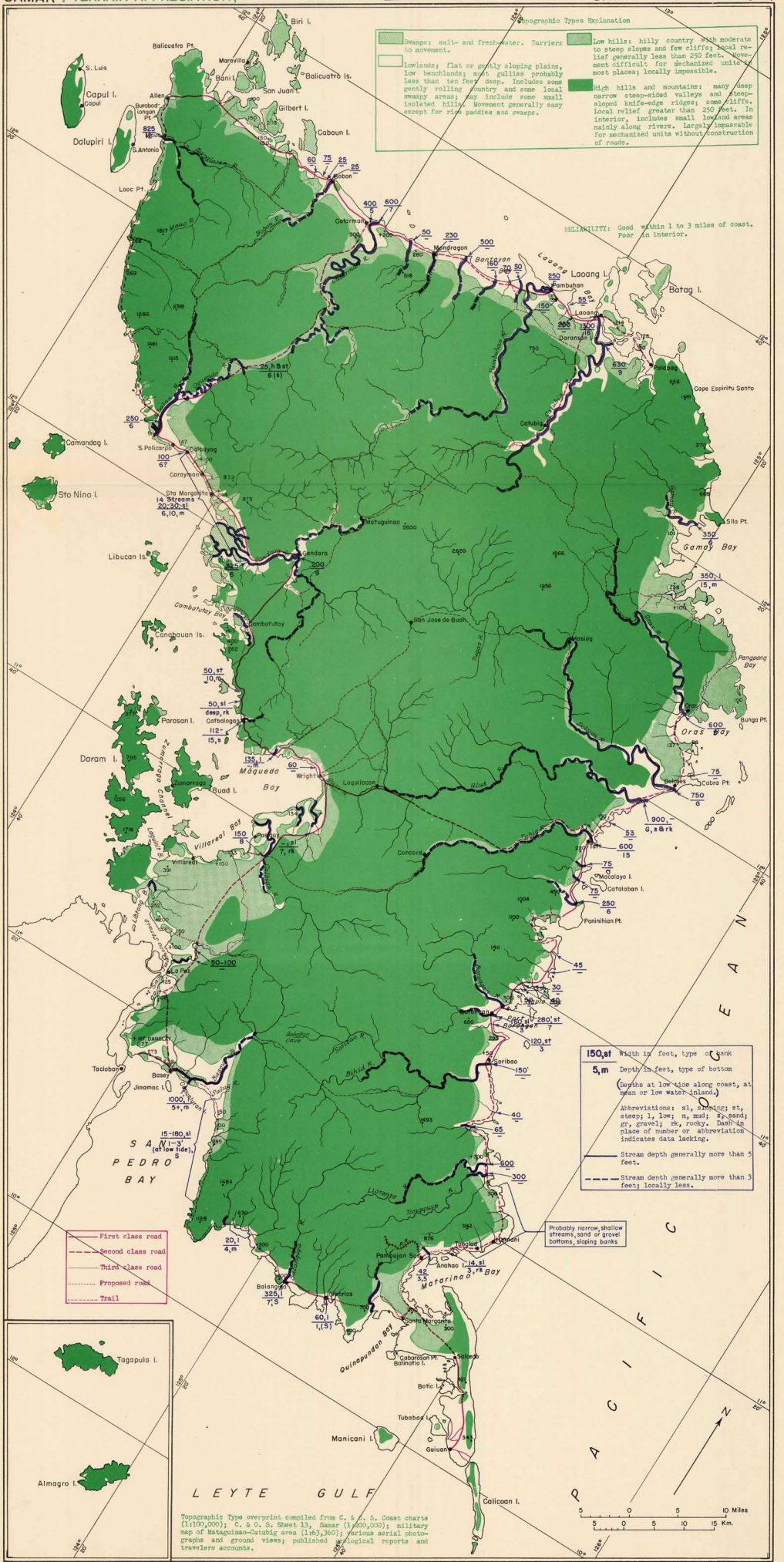

BUSUANGA ISLAND
CALAMIAN GROUP
2140
ILIN ISLAND
SEMIRARA ISLAND
SEMIRARA ISLANDS
CALUYA
SIBAY ISLAND
12°
Coron Bay
2010
CORON ISLAND
325
CULION ISLAND
1560
Linapacan Strait
760
1084
LINAPACAN ISLAND
CABULAUAN ISLANDS
1010
QUINILUBAN GROUP
ILOG ISLAND
CUYO ISLANDS
11°
851
CUYO ISLAND
965
DALANGANEM ISLANDS
1024
DUMARAN ISLAND
675
PALAWAN
(Eastern Extremity)
10°
CAGAYAN ISLANDS
205
SULU S
9°
120°
121°



CONFIDENTIAL

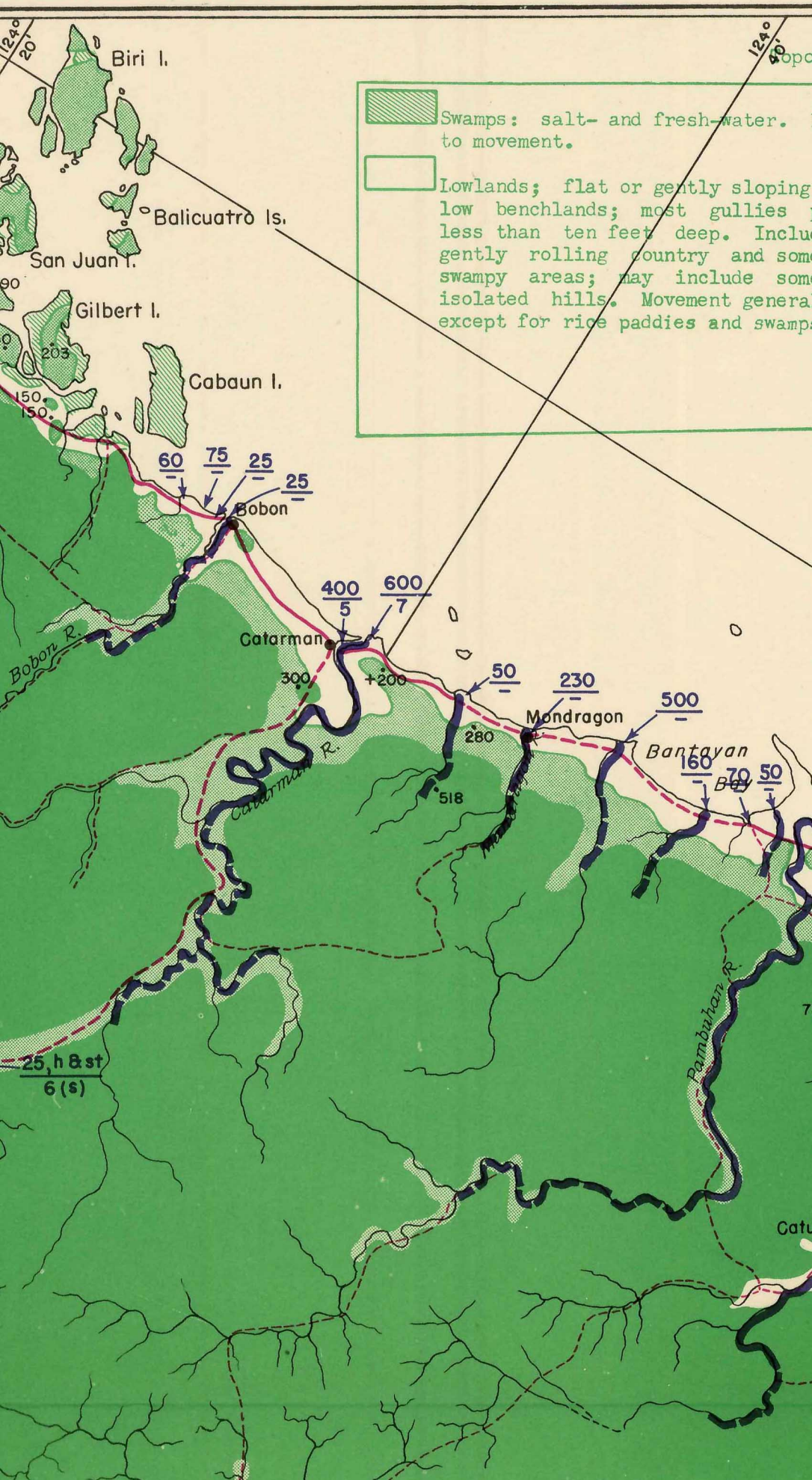


PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY


Topographic Types Explanation
Swamps; salt- and fresh-water. Barriers to movement.
Lowlands; flat or gently sloping plains, low benchlands; many gullies probably less than ten feet deep. Includes some gently rolling country and some local swampy areas; may include some small isolated hills. Movement generally easy except for rice paddies and swamps.
Low hills; hilly country with moderate to steep slopes and few cliffs; local relief generally less than 250 feet. Movement difficult for mechanized units in most places; locally impossible.
High hills and mountains; many deep narrow steep-sided valleys and steep-sloped knife-edge ridges; some cliffs. Local relief greater than 250 feet. In interior, includes small lowland areas mainly along rivers. Largely impassable for mechanized units without construction of roads.
RELIABILITY: Good within 1 to 3 miles of coast. Poor in interior.
150,st Width in feet, type of bank
5,m Depth in feet, type of bottom
(Depths at low tide along coast, at mean or low water inland.)
Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.
Stream depth generally more than 5 feet.
Stream depth generally more than 3 feet; locally less.
Probably narrow, shallow streams, sand or gravel bottoms, sloping banks
First class road
Second class road
Third class road
Proposed road
Trail
Topographic Type overprint compiled from C. & G. S. Coast charts (1:100,000); C. & G. S. Sheet 13, Samar (1:200,000); military map of Mataguinao-Catubig area (1:63,360); various aerial photographs and ground views; published geological reports and travelers accounts.
10 Miles
15 Km.
PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY
Biri I.
Balicuatro Pt.
Balicuatro Is.
San Juan I.
Gilbert I.
Cabaun I.
Capul I.
Dalupiri I.
Looc Pt.
Catarman
Mondragon
Laoang I.
Batag I.
Cape Espiritu Santo
Catubig
Camandag I.
Sto Nino I.
Libucan Is.
Matuguinao
Gandara
Gamay Bay
Sila Pt.
Lambatutay
San Jose de Buan
Tagas
Oras Bay
Bungo Pt.
Cabra Pt.
Parasan I.
Daram I.
Zumorraga
Buad I.
Maqueda Bay
Loquilocon
Villareal Bay
Concord
Catalaban I.
Paninihon Pt.
Tacloban
Basey
Jinamac I.
SAN PEDRO BAY
Caribao
Bihid R.
Lianga
Tanguisan R.
Pambujan Sur
Anahao I.
Matarinao Bay
Balangiga
Victorias
Quinapundan Bay
Santa Margarita
Cabaruan Pt.
Balinatio I.
Salcedo
Botic I.
Tubabao I.
Manicani I.
Guiuan
Calicoan I.
LEYTE GULF
PACIFIC OCEAN
Tagapula I.
Almagro I.

SAMAR : TERRAIN APPRECIATION, GE




124° 20'
Biri I.
Balicuatro Is.
San Juan I.
Gilbert I.
203
Cabaun I.
150
150
60
75
25
25
Bobon
Bobon R.
400
5
600
7
Catarman
300
+200
50
230
500
Mondragon
280
Bantayan
160
70
50
Catarman R.
518
Pambuhan R.
25, h & st
6 (s)
124° 40'
Swamps: salt- and fresh-water.
to movement.
Lowlands; flat or gently sloping
low benchlands; most gullies
less than ten feet deep. Inclu
gently rolling country and som
swampy areas; may include som
isolated hills. Movement genera
except for rice paddies and swamp

SAMAR AND LEYTE (P.I.)

ographic Types Explanation

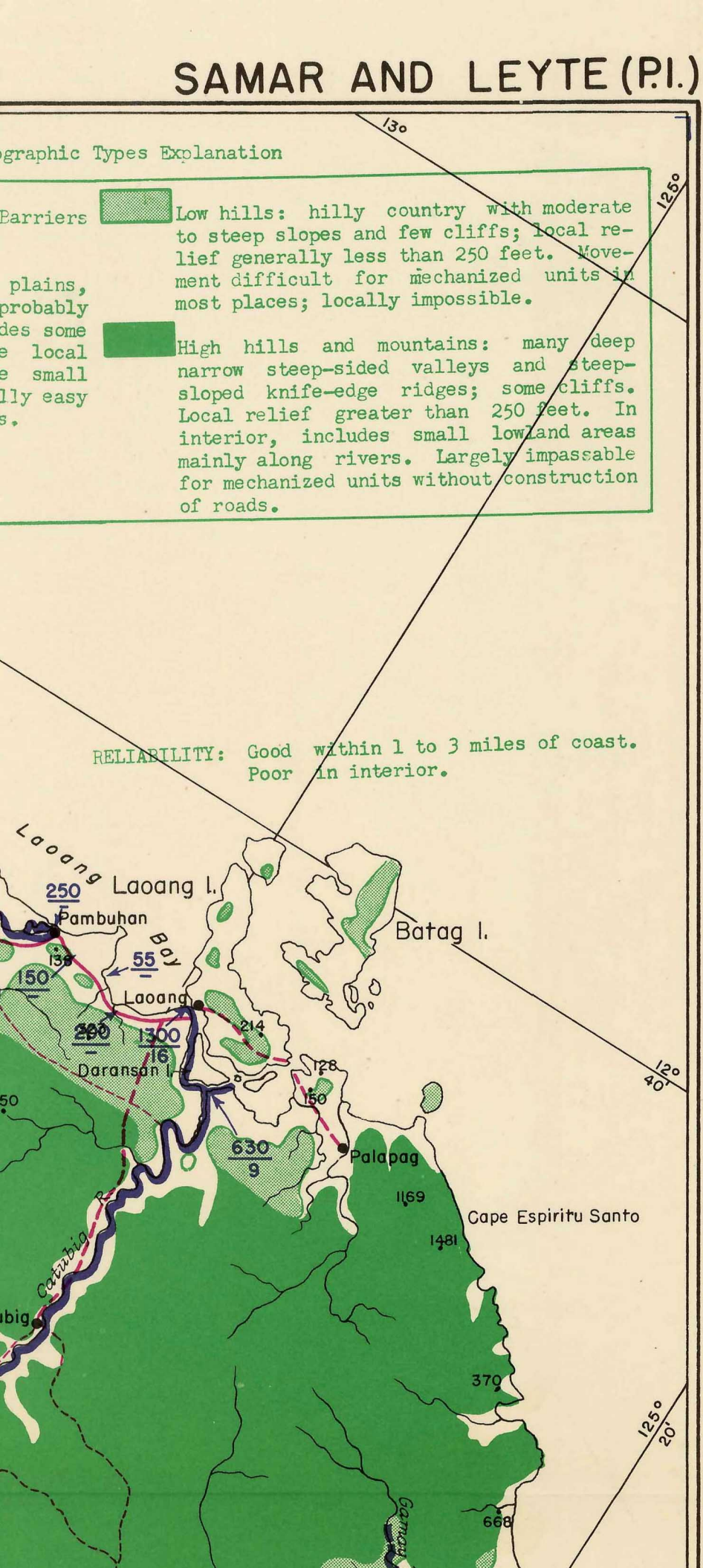
Barriers

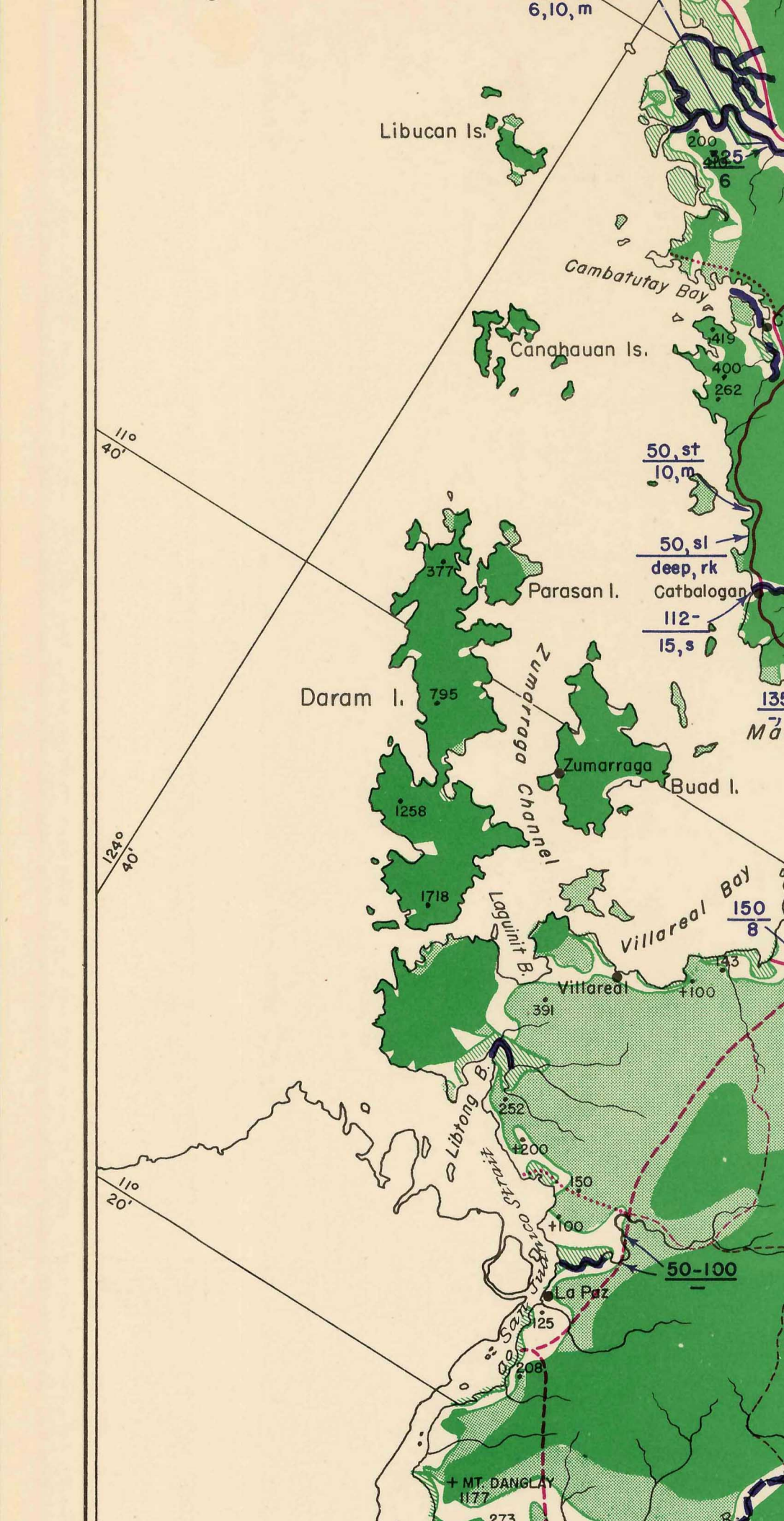
plains, probably des some e local e small lly easy s.

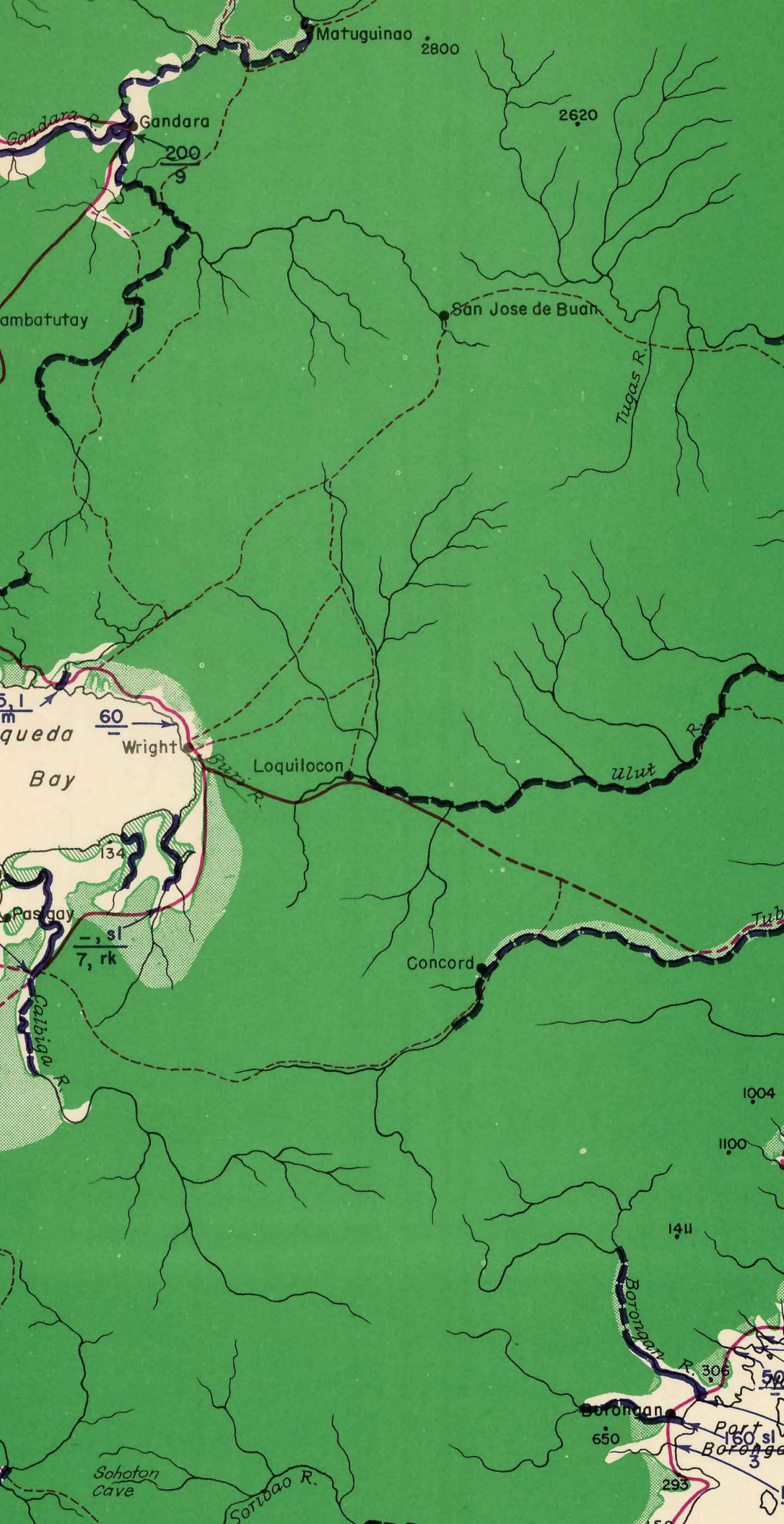
Low hills: hilly country with moderate to steep slopes and few cliffs; local relief generally less than 250 feet. Movement difficult for mechanized units in most places; locally impossible.

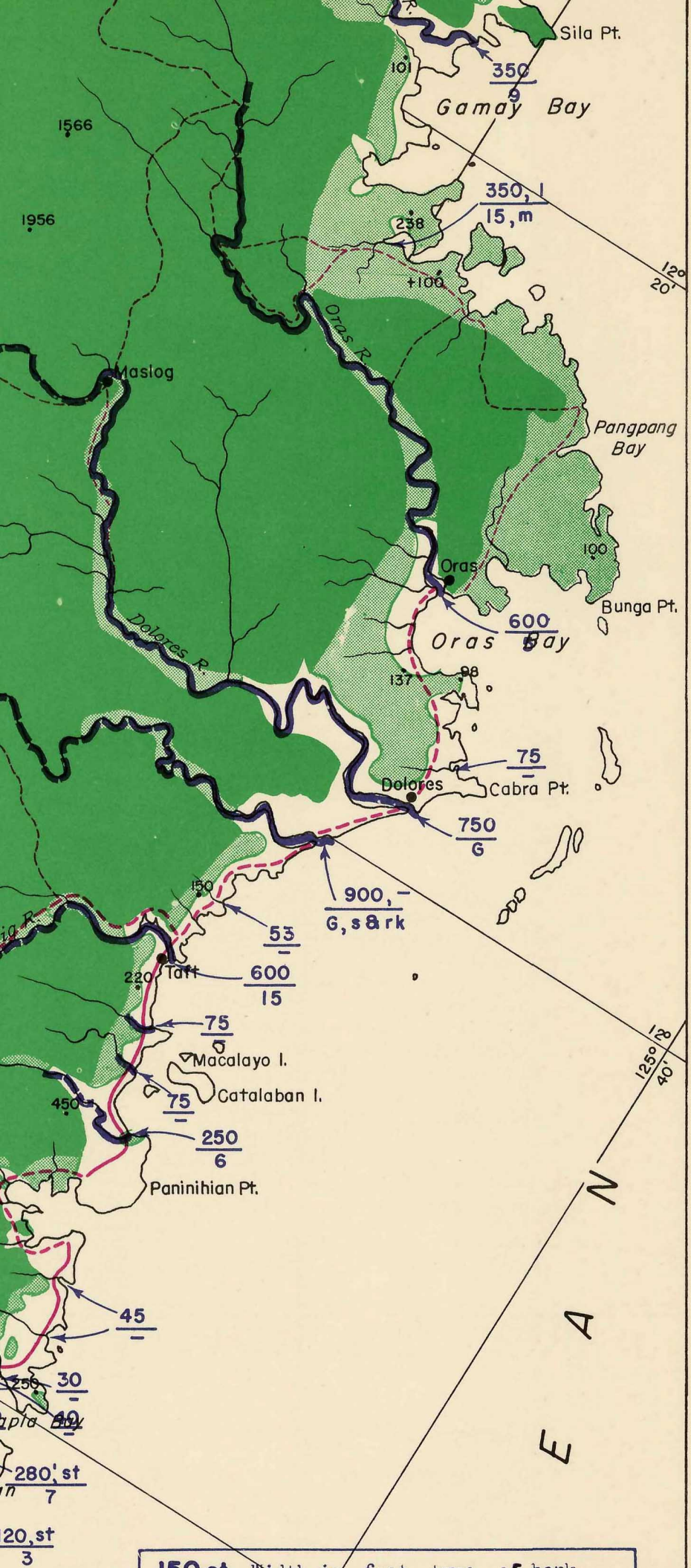
High hills and mountains: many deep narrow steep-sided valleys and steep-sloped knife-edge ridges; some cliffs. Local relief greater than 250 feet. In interior, includes small lowland areas mainly along rivers. Largely impassable for mechanized units without construction of roads.

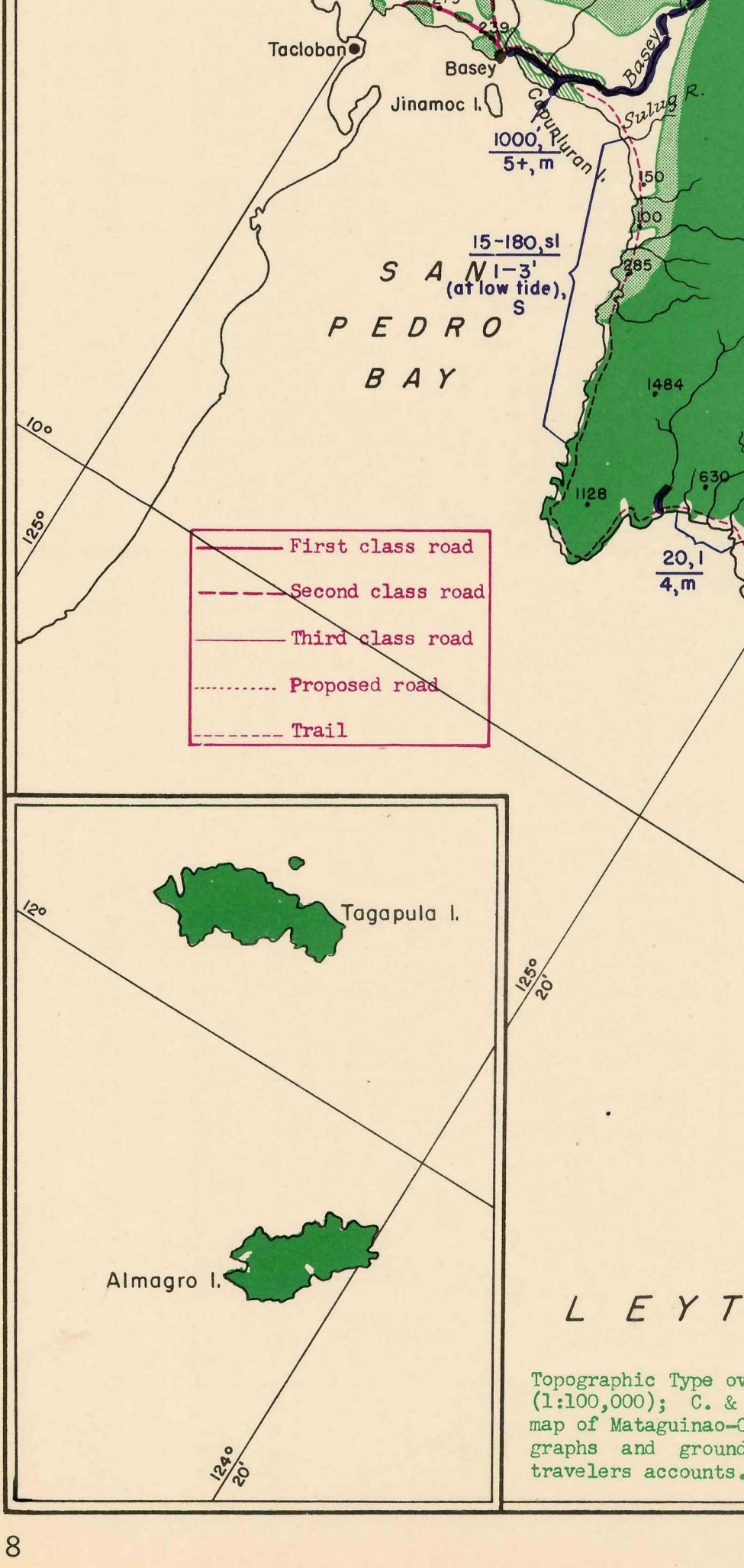
RELIABILITY: Good within 1 to 3 miles of coast.
Poor in interior.



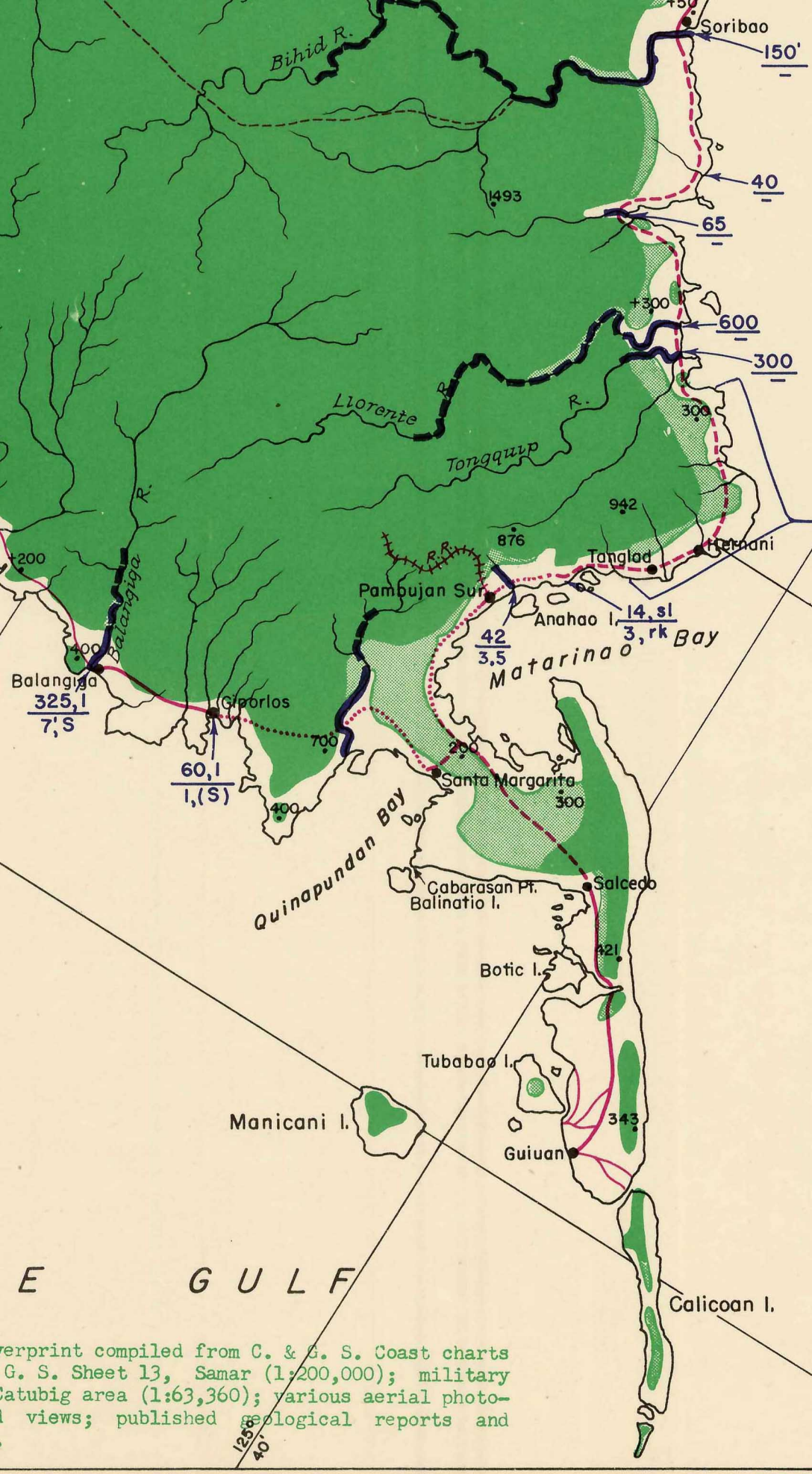

6,10, m
Libucan Is.
200
225
6
Cambatutay Bay
Canahauan Is.
419
400
262
110°
40'
50, st
10, m
50, sl
deep, rk
Catbalogan
112-
15, s
377
Parasan I.
Daram I.
795
Zumarraga Channel
Zumarraga
Buad I.
1258
1718
124°
40'
Laguinit B.
Villareal Bay
150
8
133
Villareal
+100
391
Libtong B.
252
±200
150
+100
Mapanuz Strait
50-100
La Paz
125
208
110°
20'
+ MT. DANGLAY
1177
273


Matuguinao
2800
Gandara R.
Gandara
200
9
2620
ambatutay
San Jose de Buan
Tugas R.
60
Wright
Loquilocon
Bay
Bun. R.
Ulut
134
Pasagay
7, rk
Concord
Tub
Calbiga R.
1004
1100
1411
Borongan R.
306
Borongan
650
Port
160 sl
3
293
Sohoton Cave
Sorsogon R.


Sila Pt.
350
9
Gamay Bay
1566
1956
350, l
15, m
238
+100
120
20'
Oras R.
Maslog
Pangpang Bay
100
Oras
Bunga Pt.
600
G
Oras Bay
Dolores R.
137
98
75
Dolores
Cabra Pt.
750
G
150
900, –
G, s & rk
53
220
Taft
600
15
75
Macalayo I.
450
75
Catalaban I.
250
6
Paninihian Pt.
12
125°
40'
45
256
30
40
280, st
7
20, st
3
E A N



Topographic Type ov
(1:100,000); C. &
map of Mataguinao-C
graphs and ground
travelers accounts.



verprint compiled from C. & G. S. Coast charts
G. S. Sheet 13, Samar (1:200,000); military
Catubig area (1:63,360); various aerial photo-
l views; published geological reports and
.

CONFIDENTIAL

150,sf Width in feet, type of bank

5,m Depth in feet, type of bottom

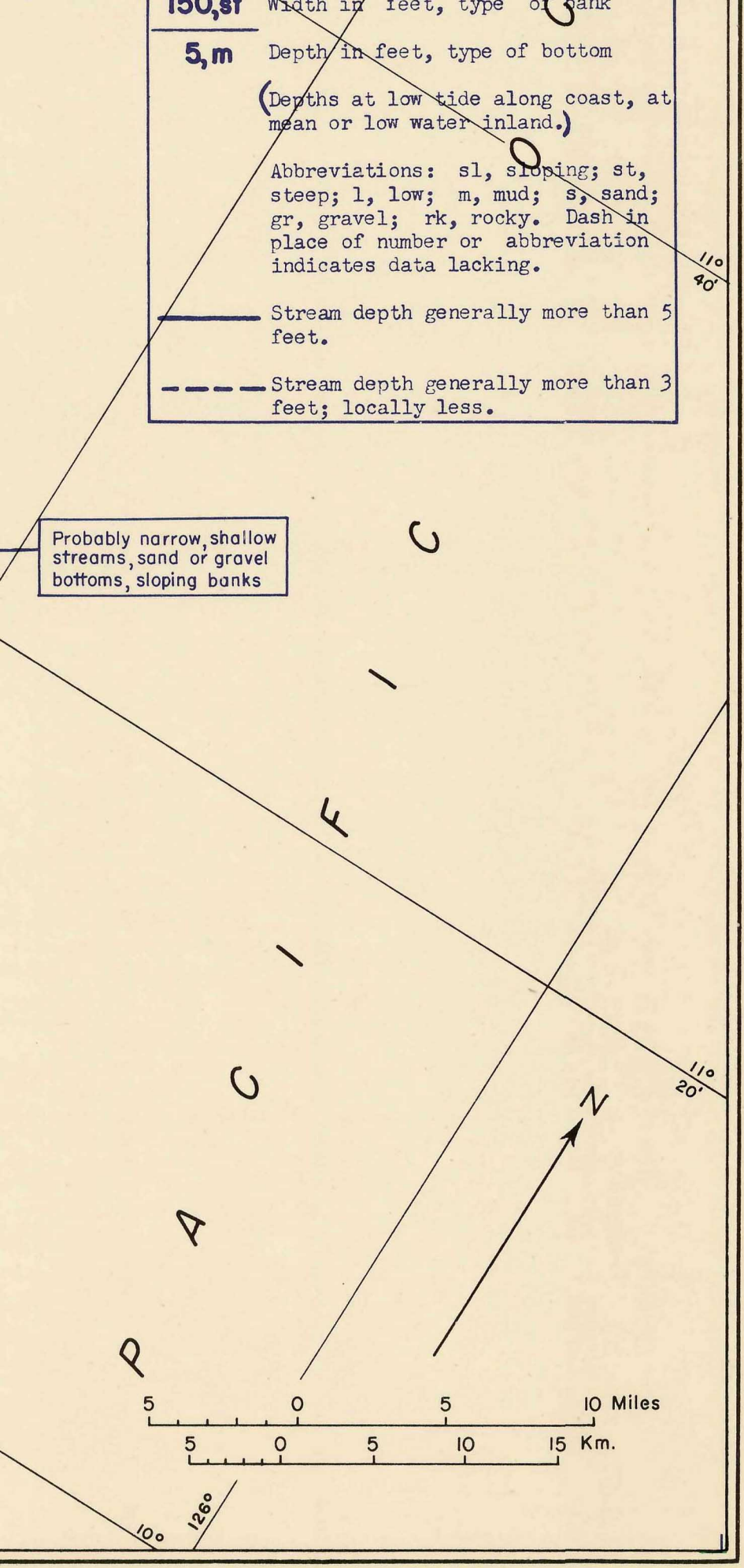
(Depths at low tide along coast, at mean or low water inland.)

Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.

——— Stream depth generally more than 5 feet.

– – – – Stream depth generally more than 3 feet; locally less.

Probably narrow, shallow streams, sand or gravel bottoms, sloping banks



PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR : TERRAIN APPRECIATION: GENERAL FEATURES

Reliability: Coastal Terrain: Good
Interior Terrain: Poor

INTRODUCTION

Information regarding the interior of Samar is inadequate and unreliable; adequate data are available only for the coastal area.

Most of island is rugged; lowlands restricted to narrow discontinuous coastal plains and flats along lower courses of the principal rivers.

Coastal lowlands are of different sizes and types; less than half a mile to five miles wide; lengths are from a few hundred feet to 35 miles. Most of the plains are low and poorly drained, in many places are covered by fresh- or salt-water swamps. Along some parts of coast, flat plains pass laterally into narrow belts of very low rolling hills. Where lowlands are lacking, the steep-sided hills extend to the shore. Locally cliffs rise abruptly from the sea or from narrow rocky beaches[a/].

Rivers are long and fairly shallow, seldom more than eight feet deep. Bottoms are sandy and silty in lower reaches; rocky with numerous falls and rapids in upper reaches. Valleys are generally broad and open with wide river flats for several miles inland where they narrow to steep-sided ravines.

Interior highlands are rugged and closely dissected. Altitudes are not great; maximum altitudes are less than 3,000 feet; generally from 600 to 2,000 feet. Summits are narrow and, in places, rocky. Slopes are steep, locally cliffed; cut by numerous steep-sided narrow ravines.

The island is densely forested, except in some coastal areas and in the major river valleys where low, poorly drained sections are cultivated to rice; higher better drained plains, to dry crops; sandy coastal strips, to coconuts; and the slopes, to coconuts and abaca. Large areas of cogon grass on the coastal hills. A few clearings either cultivated or in cogon grass are found along the major rivers in the forest areas.

Except on the sandy coastal beaches and ridges, the soil is clayey; well drained only on hill slopes. Rainfall is fairly evenly distributed throughout the year. Dry periods of as much as six weeks occur erratically. Extremely heavy rain storms are common throughout the year.

Topography on most of Samar is a barrier to movement. The few roads give access to relatively restricted areas. Two roads cross the island: one through the central parts from Wright to Taft and another from Catarman to Calbayog in the northwest corner. First and second class roads follow major coastal plains. Roads are in part suitable for heavy traffic but some require improvement for all-weather use. Foot trails are numerous.

Movement of mechanized equipment away from roads is limited to parts of the coastal plains; remainder of area is impassable for vehicles. In most places, movement is difficult even for foot troops. Steep, deeply dissected slopes, numerous narrow valleys, and deep ravines are principal obstacles. Open valleys of major rivers provide access part way into the interior but do not provide cross-island routes. Existing roads follow easiest known cross-country routes.

The larger rivers are navigable for 10 to 20 miles inland by launches having 6-foot draft. Many small streams and the middle reaches of main rivers are navigable many miles farther by bancas (small native boats).

COASTAL TERRAIN[a/]

Topography

Relief: Coastal plains generally discontinuous and narrow; from a few hundred feet to 35 miles long; from less than half a mile to 5 miles wide; generally are widest where they intersect flood plains of main rivers. In places, small isolated hills or ridges interrupt the larger plains. In many sections, hills or mountains extend to sea, forming cliffy coast, with small flats locally present at bay heads or river mouths. Mangrove and nipa (salt-water) swamps common along west coast and locally present on north and east coasts. Swamps widest at mouths of main rivers; where present elsewhere are generally discontinuous narrow fringes. Fringing coral reefs and sandy or rocky beaches are common, especially along north and east coasts. Unbroken sandy strands only locally present. Low sandy ridges commonly separate beaches from lower partly swampy areas behind. Hills and mountains that extend to sea generally only 300 to 800 feet high, but invariably very rugged; cut by numerous steep-sided valleys; generally have narrow sinuous ridges. Similar hills and mountains back all the coastal plains except where flats extend inland along rivers. Slopes are rarely below 15 or 20% and in many places 50% or more.

Rivers: Fairly shallow. Larger ones commonly 6 to 12 feet deep and several hundred yards wide near their mouths. Beds are sandy to silty, locally gravelly near mountains. Currents sluggish to moderate, except in times of flood.

Vegetation: Rice paddies common on river and coastal flats. Some bamboo thickets along streams. Coastal swamps mainly mangrove and nipa palm. On beach ridges and benchlands, coconuts and abaca are cultivated, in places on slopes of more than 50%. Hills generally covered with patchworks of cogon grass and secondary forest areas interspersed with some cultivated fields. Higher hills, mountains, and headlands rising directly from the sea generally are heavily forested.

Movement

Roads and Trails: Fair to poor motor roads exist along all extensive sections of the coastal plain; in places are built across the hills from one section of plain to another. In most other places roads are lacking, but foot trails are fairly numerous.

Railroads: A narrow-gage line runs between Pambujan Sur and an iron mine 5 miles inland.

Cross-country Movement: On coastal plains movement generally easy for foot troops and vehicles; locally restricted by swamps, paddy fields, non-fordable streams, and low hills. Such plains occupy most of north coast and more limited areas along other coasts. On hilly and mountainous areas, vehicular movement generally difficult or impossible and movement on foot difficult.

Rivers: Several rivers, the Catubig, Oras, Ulut, Dolores, Tubig, Gandara, Basey, are navigable a few miles inland by boats of 6- to 12-foot draft. Bars at river mouths can generally be crossed only at high tide. Numerous smaller rivers can be navigated by shallower-draft boats or canoes.

Observation

On coastal plains, generally restricted or poor in coconut groves, orchards, and patches of secondary forest; good within paddy-field areas, on beaches, and from local grassy hills. In highlands, good observation possible from sea-cliffs, particularly where headlands command long sections of coastal plain. In interior, observation generally restricted by dense forest, rugged terrain, and lack of commanding hills; limited observation possible in cogon-grass areas.

Concealment

In many plains coconut groves afford concealment for personnel and vehicles from aerial observation. Concealment for personnel can also be found in abaca plantations on some of the cleared slopes and in gullies. In general, forested areas offer excellent concealment for personnel but, because of rugged terrain, are not usually accessible to wheeled vehicles.

Cover

Natural Cover: On coastal plains almost only natural cover is afforded by shallow ravines and isolated hills. In highlands, numerous narrow valleys and gullies afford excellent cover. Entire widths of coastal plains can be brought under fire from bordering hills.

Artificial Cover: On coastal plains, foxholes and slit trenches can be dug readily in most places, although locally the soil may be too thin. Fair drainage except in paddy fields and on ground that is less than 6 feet above streams, swamps, or springs. In hilly or mountainous areas, soil generally deep enough for fox holes or slit trenches; ground generally water saturated; seepage serious problem. Cut-and-cover shelters can be dug except on upper ridge slopes; drainage is the main problem. Timber for wall and roof supports is abundant in most places; may be difficult to obtain in cogon grass areas. Cave shelters accessible in many parts of the coastal hills; soil and weathered rock sufficiently deep for excavation. Walls commonly subject to slumping; require support; seepage is a serious problem.

INTERIOR TERRAIN

Topography

Relief: Highly dissected hills and low mountains; a few long open river valleys. Interior of the island except along the major river valleys is mountainous or hilly. Elevations not high (maximum elevation less than 3,000 feet) and there are few prominent peaks, but the land is highly dissected and presents a complex pattern of steep-sloped ridges. Local relief commonly exceeds 500 feet; many knife-edge ridges. Most slopes probably over 20%; in places 50 to 100%; locally may be more moderate and rounded but rarely less than 15%. The highest peak in in the central part of the island. In general, the roughest, most inaccessible parts seem to be the interior mountains of the southern half of the island and the northwest corner west of the Calbayog-Catarman road. Three interior areas have somewhat less rugged topography: (1) A low hilly plateau 200 to 300 feet above sea level lies between the coastal plains at the mouths of the Palapag and Gamay Rivers. Low mountain ranges separate it from the sea on the east and from the valley of the Catubig River on the west. Some higher hills rise above the general summit level. (2) The headwaters of the Dolores River form a high broad basin, generally rolling, interrupted by a few hills (altitudes 1,900 to 2,600 feet). (3) A somewhat less rugged area, possibly a low hilly belt, connects the valleys of the Jibaton and Catarman Rivers; forms a corridor across the northwest corner of the islands. In the vicinity of Matuguinao, Sohoton Cave, in the area north of Loguilocon, and probably in many other districts where limestone is exposed, sinkholes, caves, and underground rivers are common. Few intermontane flats. The valleys of the larger rivers have flat floors for a few miles from the coast and intermittently for many miles inland; low steep-sided hills border the flats. These inland valley flats are from 2 to 5 miles across in the valley of the Catubig River, at Concord on the Tubig River, Gandara on the Gandara River, and possibly elsewhere. Other valley flats are only a few hundred yards wide. Many of these areas as at Gandara may be flooded during heavy rains.

Vegetation: The greater part of the interior is heavily forested. Much rice is cultivated in the poorly drained areas along the major rivers. In higher well-drained areas, corn and other dry crops are grown; in the hills abaca is grown. Cogon grass common where the land has been cultivated a few years and then abandoned.

Rivers: The interior is highly dissected by innumerable rivers and streams. The larger rivers have relatively deep (6 to 12 feet) channels in their lower courses; may be 6 feet deep for 10 to 20 miles inland with no obstructions to navigation. The largest river, the Catubig, has more than 12 feet of water 10 miles from the mouth. In general, currents are slow except at flood stages. For some distance inland the bottoms are probably silt or sand. The upper reaches of the large rivers, their tributaries, and the numerous small streams emptying directly into the sea flow in narrow steep-sided valleys and gullies; rocky and bouldery bottoms; many rapids and falls; generally shallow (2 to 4 feet) but subject to occasional dangerous flash floods particularly during November, December, and January. (For further information see Rivers Sheet).

Movement

General: Barrier area; motorized movement limited to roads; foot movement exceedingly difficult. Lower parts of several larger rivers navigable by boats having 4- to 10-foot draft.

Roads and Trails: (See Road Construction and Maintenance Sheet for details) Two roads cross the area: a second-class road connecting the north coast at Catarman with the west coast at Calbayog and a road from Wright on the west coast to Taft on the east coasts. Neither road could carry heavy traffic without constant maintenance; each would be difficult to maintain. The Taft-Wright Road, in part first-class, in part second-class, crosses very rugged country; is in part cut into cliffs along the Tubig River; during the winter it is often impassable. Detours impossible over most of route. The Catarman-Calbayog Road probably traverses less difficult country; detours may be possible in places. All the longer rivers, navigable by native bancas, and many of the small inland villages are connected by foot trails that seem to follow stream courses. Trails rarely follow ridges for any distance as the crests generally are too sharp and crooked. Trails from Laoang on west coast are via the Pambuhan or Catubig Rivers and Gandara. A trail between the Catubig and Oras Rivers forms a communication route between the north and east coast. Borongan on the southeast coast is linked to Basey at the southwest and to Calbiga by a trail between Soribao and Calbiga Rivers. Trails are generally poor. Only two known trails south of the Wright-Taft road; no north-south communication through central part of island.

Rivers: The Catubig River is the most important; boats of 12-foot draft can reach Catubig. All the larger rivers are lines of communication and are navigable for 10 to 20 miles inland by boats of 5- or 6-foot drafts and many miles farther by bancas; portages around falls and rapids are often necessary. The trip from Lo uilocum to the west coast has been made by banca in three days. Against the current, movement is probably much slower. Except for the lower courses of the larger rivers, all can be forded. Occasional flash floods make the small streams dangerous.

Cross-country Movement: Movement by vehicles is impossible; is extremely difficult for foot troops. Footing generally poor. The soil is a crumbly clay loam; naturally well drained but becomes muddy and sticky when wet. Jungle, steep-hill slopes, numerous steep-sided gullies, and stream crossings are obstacles. In the cleared areas in the river valleys, rice paddies are serious obstacles.

Observation

Ground and aerial observation extremely poor because of heavy forests and very rough topography.

Concealment

Excellent concealment provided by heavy forest and numerous ravines.

Cover

Natural Cover: Excellent cover for personnel is provided by the numerous ravines and gullies. In most places, vehicles can not leave the roads. Roads and trails subject to ambush and fire from bordering hills.

Hasty Fortifications: Fox holes and slit trenches somewhat difficult to dig because of angle of slope and heavy root tangles; provision generally can be made for adequate drainage. Cut-and-cover shelters: conditions similar to fox holes and slit trenches. Excavation is facilitated by deep weathering (softening) of rock in many places; drainage is main problem. Abundant timber for roof and wall supports. Cave shelters: soil and zone of soft weathered rock commonly deep enough to make excavation possible; slumps badly; would need support and provision for drainage.

a/ For further information on Coastal Terrain see Samar: Terrain Appreciation, Coastal Detail Sheet.

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

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[redacted]AL

SAMAR : TERRAIN A

Reliability: Coastal Terrain: Good
Interior Terrain: Poor

Movement

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cliffy coast, with small flats locally present at bay head or river mouths. Mangrove and nipa (salt-water) swamps common along west coast and locally present on north and east coasts. Swamps widest at mouths of main rivers; wher present elsewhere are generally discontinuous narrow fring Fringing coral reefs and sandy or rocky beaches are common especially along north and east coasts. Unbroken sandy strands only locally present. Low sandy ridges commonly separate beaches from lower partly swampy areas behind. Hills and mountains that extend to sea generally only 300 800 feet high, but invariably very rugged; cut by numerous steep-sided valleys; generally have narrow sinuous ridges. Similar hills and mountains back all the coastal plains except where flats extend inland along rivers. Slopes are rarely below 15 or 20% and in many places 50% or more.

Rivers: Fairly shallow. Larger ones commonly 6 to 1 feet deep and several hundred yards wide near their mouths Beds are sandy to silty, locally gravelly near mountains. Currents sluggish to moderate, except in times of flood.

Vegetation: Rice paddies common on river and coastal flats. Some bamboo thickets along streams. Coastal swamp mainly mangrove and nipa palm. On beach ridges and benchlands, coconuts and abaca are cultivated, in places o slopes of more than 50%. Hills generally covered with patchworks of cogon grass and secondary forest areas inter spersed with some cultivated fields. Higher hills, mounta and headlands rising directly from the sea generally are heavily forested.

ridges. Local relief commonly exceeds 500 feet; many knife-edge ridges. Most slopes probably over 20%; in places 50 to 100%; locally may be more moderate and rounded but rarely less than 15%. The highest peak is in the central part of the island. In general, the roughest, most inaccessible parts seem to be the interior mountains of the southern half of the island and the northwest corner west of the Calbayog-Catarman road. Three interior areas have somewhat less rugged topography: (1) A low hilly plateau 200 to 300 feet above sea level lies between the coastal plains at the mouths of the Palapag and Gamay Rivers. Low mountain ranges separate it from the sea on the east and from the valley of the Catubig River on the west. Some higher hills rise above the general summit level. (2) The headwaters of the Dolores River form a high broad basin, generally rolling, interrupted by a few hills (altitudes 1,900 to 2,600 feet). (3) A somewhat less rugged area, possibly a low hilly belt, connects the valleys of the Jibaton and Catarman Rivers; forms a corridor across the northwest corner of the islands. In the vicinity of Matuguinao, Sohoton Cave, in the area north of Loguilocon, and probably in many other districts where limestone is exposed, sinkholes, caves, and underground rivers are common. Few intermontane flats. The valleys of the larger rivers have flat floors for a few miles from the coast and intermittently for many miles inland; low steep-sided hills border the flats. These inland valley flats are from 2 to 5 miles across in the valley of the Catubig River, at Concord on the Tubig River, Gandara on the Gandara River, and possibly elsewhere. Other valley flats are only a few hundred yards wide. Many of these areas as at Gandara may be flooded during heavy rains.

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a/ For further information on Coastal Terrain see Samar: Terrain Appreciation, Coastal Detail Sheet.

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Ground and aerial observation extremely poor because of heavy forests and very rough topography.

Concealment

Excellent concealment provided by heavy forest and numerous ravines.

Cover

Natural Cover: Excellent cover for personnel is provided by the numerous ravines and gullies. In most places, vehicles can not leave the roads. Roads and trails subject to ambush and fire from bordering hills.

Hasty Fortifications: Fox holes and slit trenches somewhat difficult to dig because of angle of slope and heavy root tangles; provision generally can be made for adequate drainage. Cut-and-cover shelters: conditions similar to fox holes and slit trenches. Excavation is facilitated by deep weathering (softening) of rock in many places; drainage is main problem. Abundant timber for roof and wall supports. Cave shelters: soil and zone of soft weathered rock commonly deep enough to make excavation possible; slumps badly; would need support and provision for drainage.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR TERRAIN APPRECIATION COASTAL DETAIL [redacted] SAMAR AND LEYTE (P.I.)

Brackets and numbers refer to Coastal Terrain units described in text.

Topographic Types Explanation

Swamps: salt- and fresh-water. Barriers to movement.

Lowlands; flat or gently sloping plains, low benchlands; most gullies probably less than ten feet deep. Includes some gently rolling country and some local swampy areas; may include some small isolated hills. Movement generally easy except for rice paddies and swamps.

Low hills; hilly country with moderate to steep slopes and few cliffs; local relief generally less than 250 feet. Movement difficult for mechanized units in most places; locally impossible.

High hills and mountains: many deep narrow steep-sided valleys and steep-sloped knife-edge ridges; some cliffs. Local relief greater than 250 feet. In interior, includes small lowland areas mainly along rivers. Largely impassable for mechanized units without construction of roads.

RELIABILITY: Good within 1 to 3 miles of coast. Poor in interior.

150,st Width in feet, type of bank
5,m Depth in feet, type of bottom
(Depths at low tide along coast, at mean or low water inland.)

Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.

Stream depth generally more than 5 feet.

Stream depth generally more than 3 feet; locally less.

Probably narrow, shallow streams, sand or gravel bottom, sloping banks

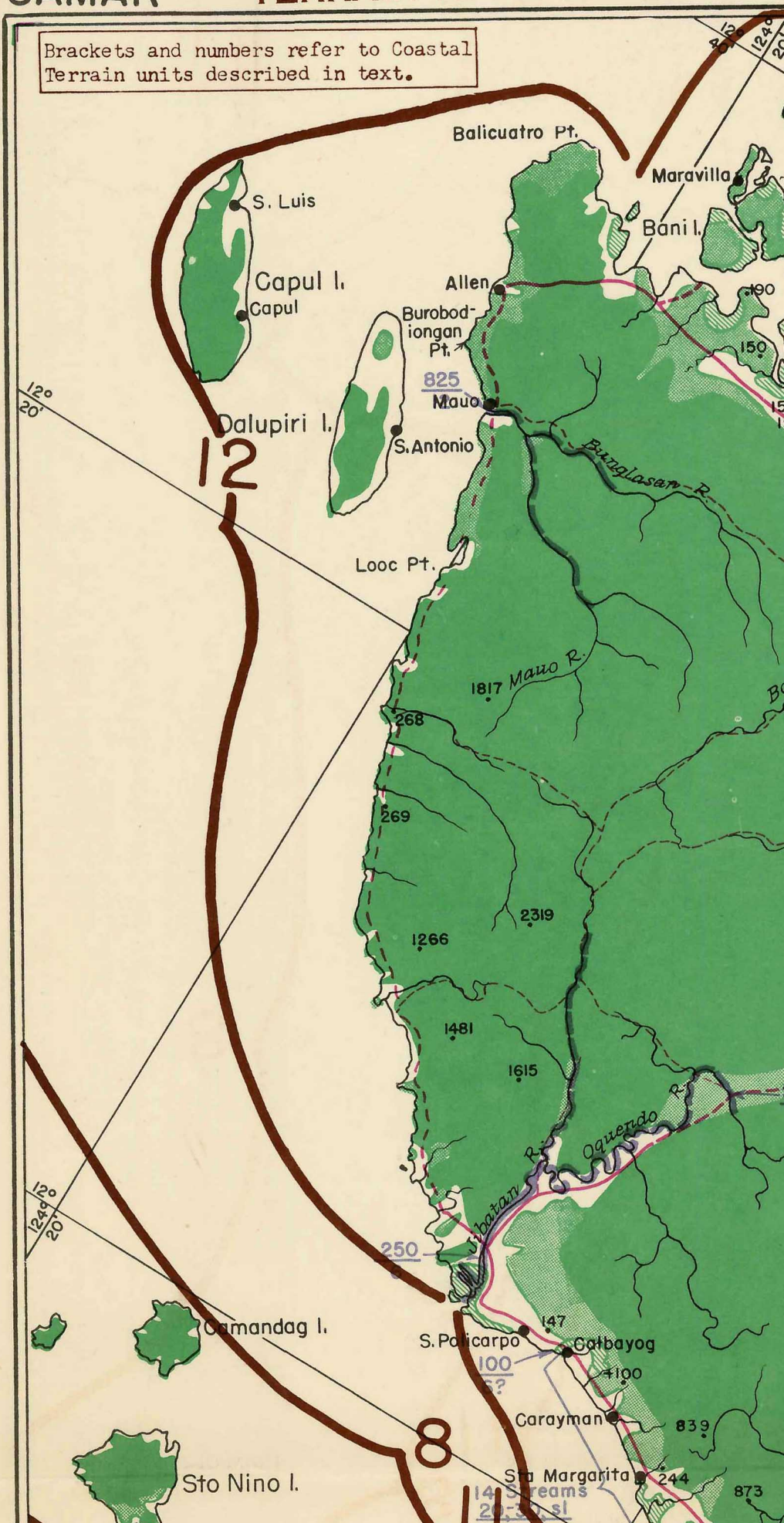
First class road
Second class road
Third class road
Proposed road
Trail

Topographic Type overprint compiled from C. & G. S. Coast charts (1:100,000); C. & G. S. Sheet 13, Samar (1:200,000); military map of Matagulnao-Catubig area (1:63,360); various aerial photographs and ground views; published geological reports and travelers accounts.

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

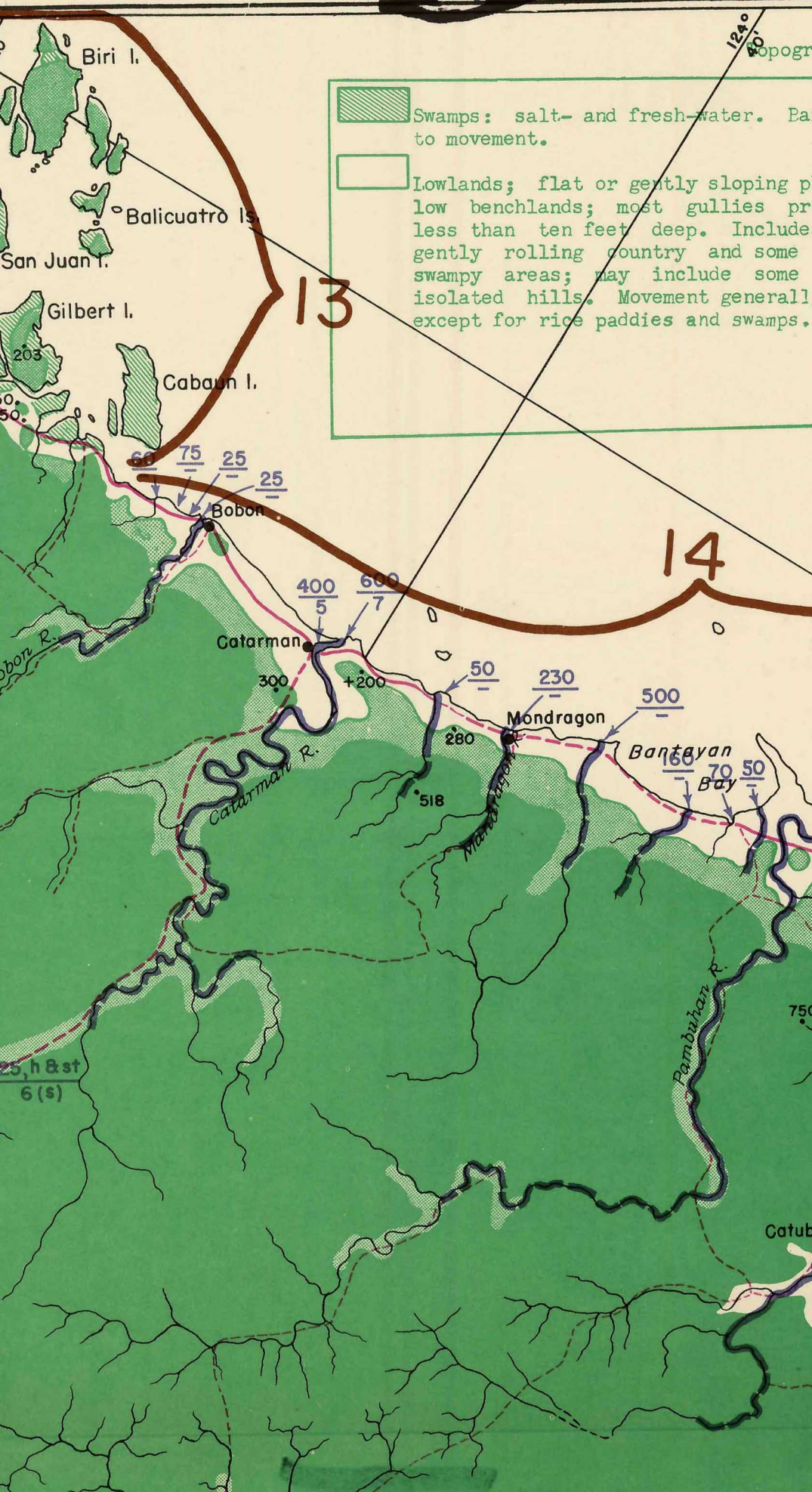
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SAMAR TERRAIN APPRECIATION C



OASTAL DETAIL

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SAMAR AND LEYTE (P.I.)

raphic Types Explanation

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local
small
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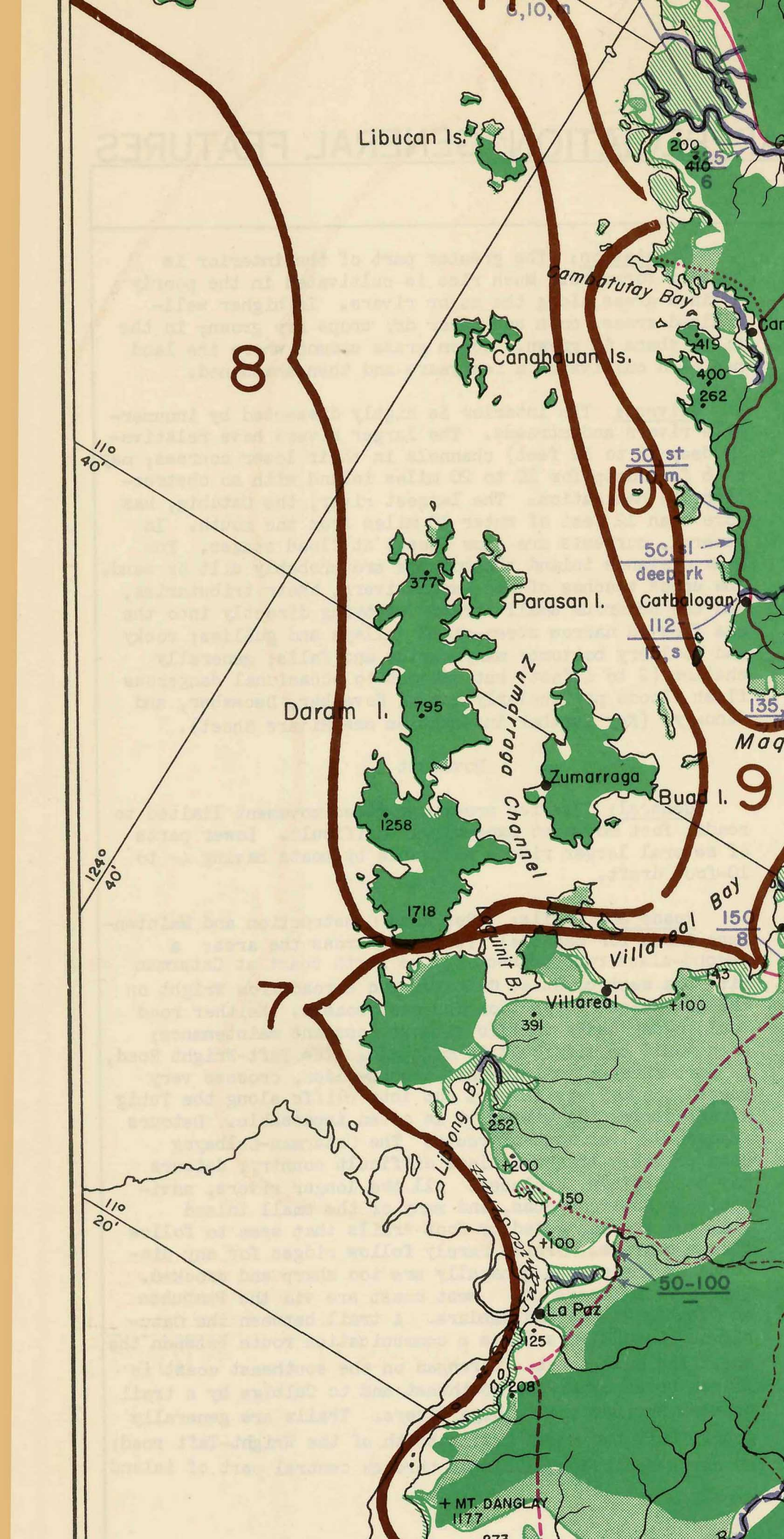
Low hills: hilly country with moderate to steep slopes and few cliffs; local relief generally less than 250 feet. Movement difficult for mechanized units in most places; locally impossible.

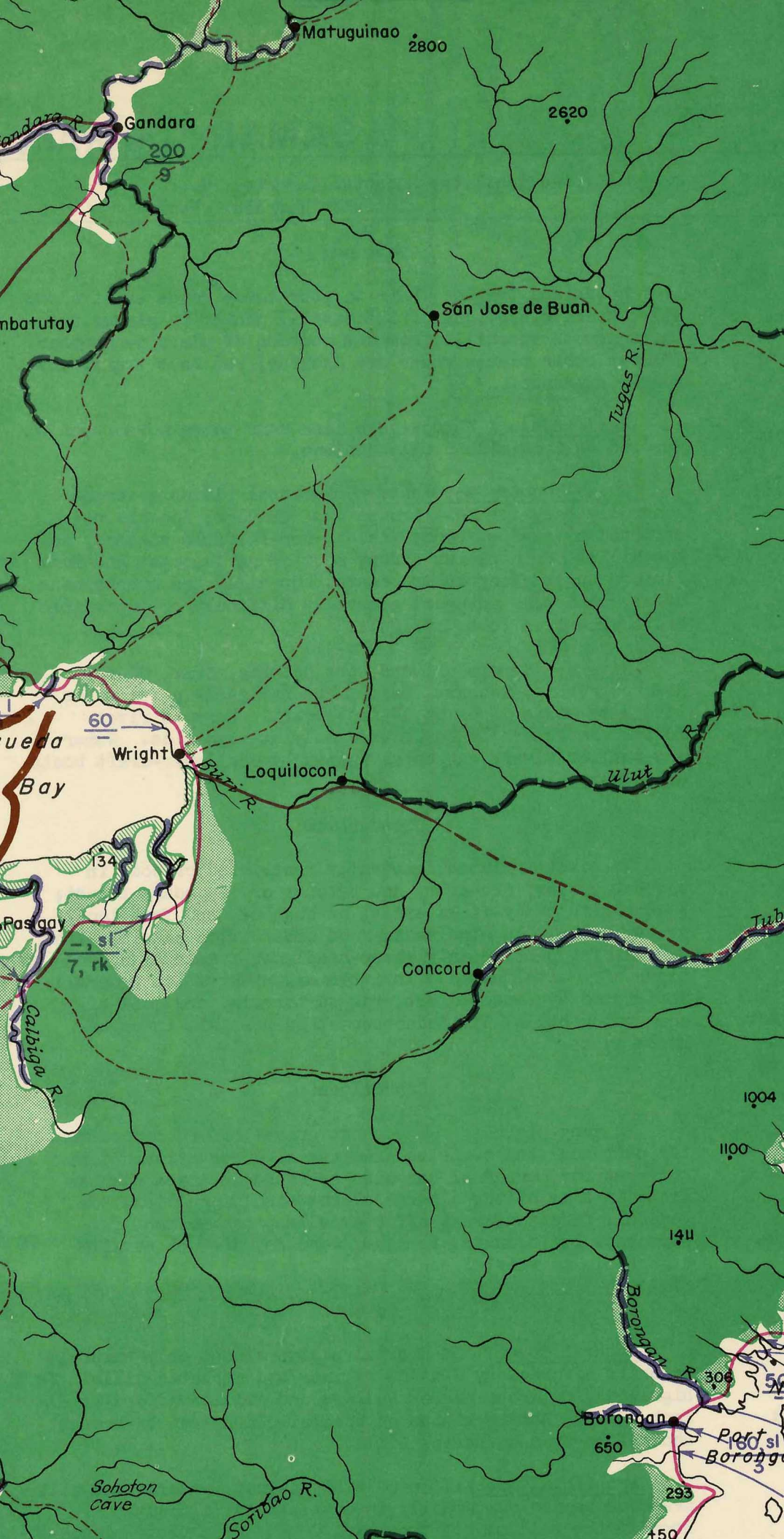
High hills and mountains: many deep narrow steep-sided valleys and steep-sloped knife-edge ridges; some cliffs. Local relief greater than 250 feet. In interior, includes small lowland areas mainly along rivers. Largely impassable for mechanized units without construction of roads.

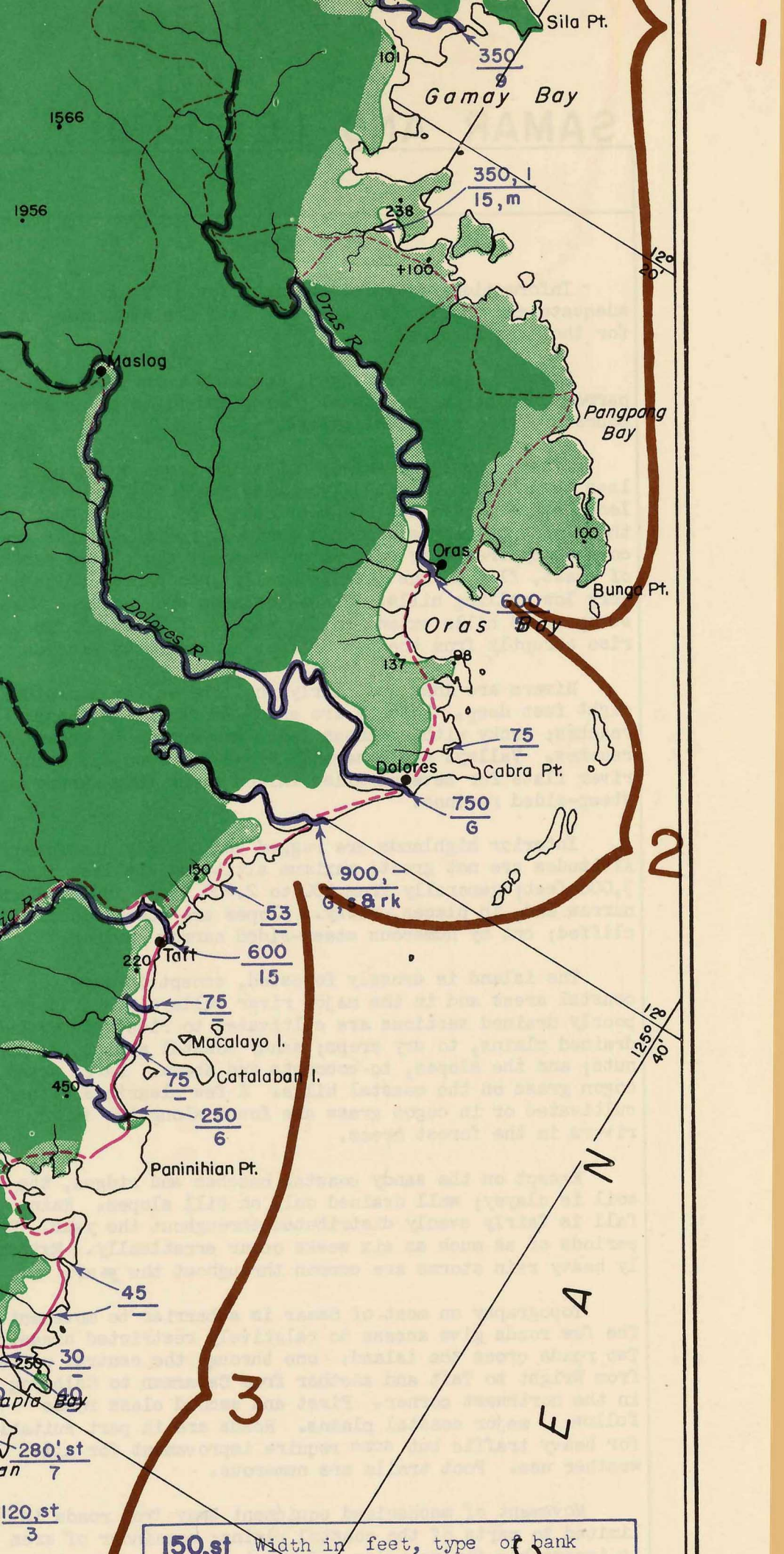
RELIABILITY: Good within 1 to 3 miles of coast.
Poor in interior.

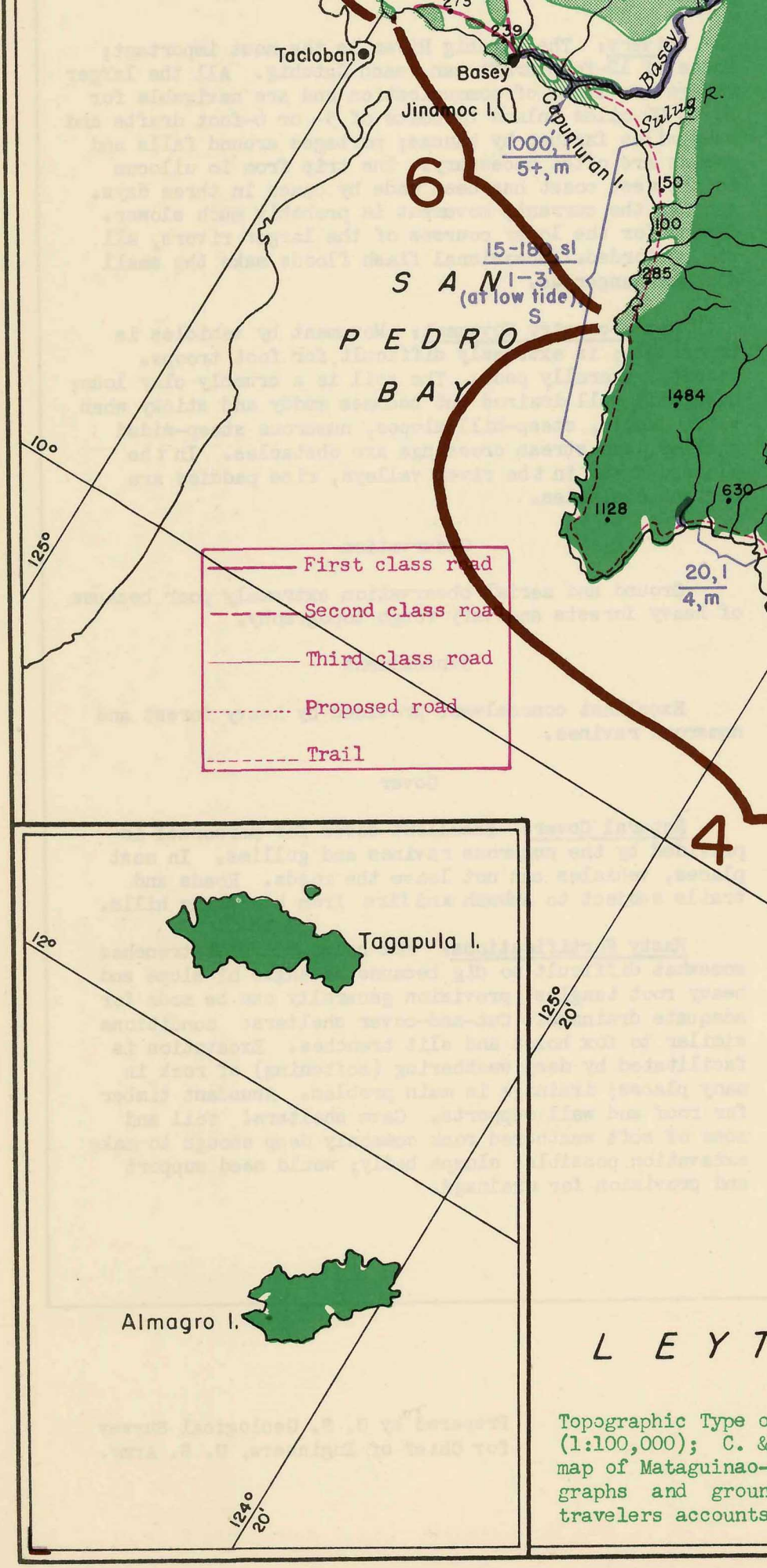
130
125°
120
40'
125°
20'

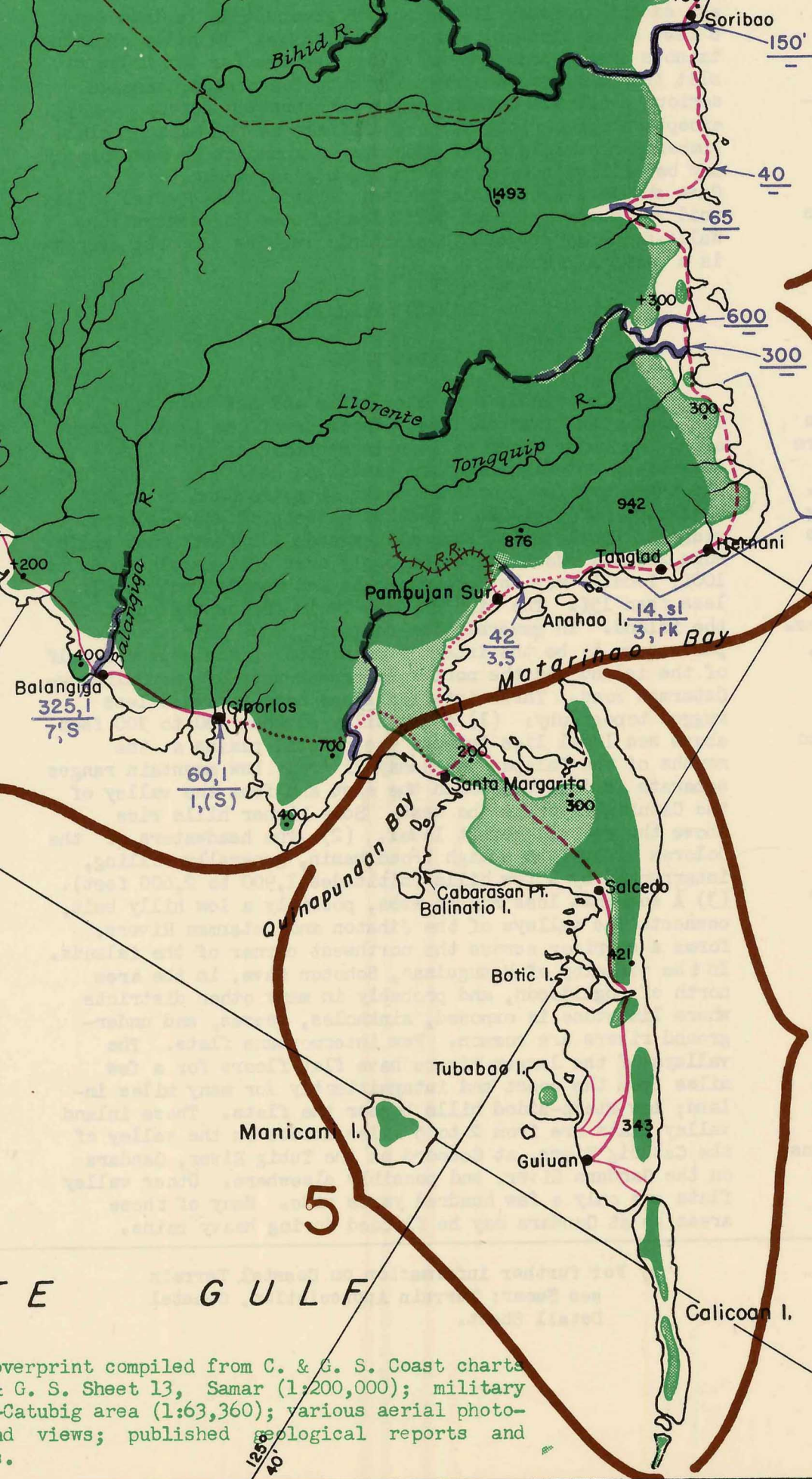
Laoang
Laoang I.
Batag I.
Pambuhan
Bay
Laoang
Daransan I.
Palapag
Cape Espiritu Santo
Catubig R.
Catubig
Gamay R.
250
55
138
150
220
1300
16
214
128
150
630
9
1169
1481
379
668


Libucan Is.
Cambatutay Bay
Canahauan Is.
8
10
9
7
110° 40'
124° 40'
110° 20'
Parasan I.
Catbalogan
Daram I.
795
377
Zumarraga Channel
Zumarraga
Buad I.
1258
1718
Villareal Bay
Villareal
391
252
+200
150
+100
La Paz
125
208
50-100
+ MT. DANGLAY
1177
200
410
415
400
262
112
143
+100


Matuguinao
2800
2620
Gandara
200
9
San Jose de Buan
Tugas R.
60
Wright
Loquilocon
Burn R.
Ulut R.
Bay
134
Pasgay
7, rk
Concord
Calbiga R.
1004
1100
141
Borongan R.
306
Borongan
650
160, sl
293
150
Sohoton Cave
Sorbao R.


Sila Pt.
101
350
Gamay Bay
1566
350, 1
15, m
1956
238
+100
Oras R.
Maslog
Pangpang Bay
100
Oras
Bunga Pt.
600
Oras Bay
Dolores R.
137
98
75
Dolores
Cabra Pt.
750
6
900, —
6, s & rk
130
53
220
Taft
600
15
75
Macalayo I.
75
Catalaban I.
450
250
6
Paninihian Pt.
45
30
40
280, st
7
120, st
3
1
2
3
E A N
125° 12' 40'
120° 20'
150.st Width in feet, type of bank


Tacloban
Basey
Jinamoc I.
Capuluran I.
Basey
Sulug R.
1000,
5+, m
6
15-18
1-3'
(at low tide)
S A N
P E D R O
B A Y
150
100
285
1484
630
1128
20,
4, m
100
125°
First class road
Second class road
Third class road
Proposed road
Trail
4
Tagapula I.
Almagro I.
120
125° 20'
124° 20'
L E Y T
Topographic Type
(1:100,000); C. &
map of Mataguinao-
graphs and groun
travelers accounts



TE GULF

overprint compiled from C. & G. S. Coast charts
& G. S. Sheet 13, Samar (1:200,000); military
-Catubig area (1:63,360); various aerial photo-
nd views; published geological reports and
.

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5,m Depth in feet, type of bottom

(Depths at low tide along coast, at mean or low water inland.)

Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.

——— Stream depth generally more than 5 feet.

– – – – Stream depth generally more than 3 feet; locally less.

Probably narrow, shallow streams, sand or gravel bottoms, sloping banks

4

5

110° 40'

110° 20'

126°

10°

P A C I F I C O C E A N

N

5 0 5 10 Miles

5 0 5 10 15 Km.

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR TERRAIN APPRECIATION : COASTAL DETAIL

Reliability: Good

Map Unit	Topography	Ground Conditions	Movement
1	No coastal plains except small area at mouth of Gamay River; beaches between Pangpang Bay and Bunga Point. From Oacan Point to Sila Point, precipitous mountains rise abruptly from shore. In vicinity of Cape Espiritu Santo, slopes are in part almost vertical; high-water line is bordered by heaped boulders. South of Sila Point, coastal hills are lower; have more moderate slopes; backed by higher mountains. Heads of bays generally muddy.	Hills and mountains heavily forested. South of Sila Point swamps border many parts of coast; extend inland a mile or two along the rivers. Soil is clay loam. Footing poor.	No roads. One trail and navigable river. Movement impossible for vehicles and very difficult for men. Heavy jungle and steep slopes are obstacles.
2	Coastal plain 1 to 3 miles wide connects the river plains of the Oras, Dolores, and Ulut Rivers. From south side of Oras Bay to Cabra Point, lowland restricted to a narrow band bordered by low steep-sided hills. At Oras Bay sandy beach ridge fronts the lowland. Beaches, 30 to 60 feet wide, extend southward from Cabra Point. Principal rivers are deep and wide.	Low area behind beach ridge at Oras Bay may be swampy. Behind beach south of Cabra Point, plain is grassy or covered by coconut groves with bushy undergrowth. Low poorly drained areas along the rivers cultivated to rice, hills for most part heavily wooded; locally overgrown with cogon grass. Footing good along beach ridge, but in plains ground is muddy and sticky when wet. Rice paddies provide poor footing at all times.	Second-class road southward from Oras. Vehicles probably could operate off the road when plains dry; beaches can be used at any time. Deep unfordable rivers, rice paddies, and swamps are obstacles. Dolores and Oras Rivers can be entered and navigated by boats drawing up to 6 feet of water. Mouth of Ulut River very dangerous for launches, but river is navigable for some distance above mouth.
3	Narrow coastal plain; most extensive in vicinity of Soribao River. Locally as between Borongan and the sea, the narrow coastal plain may merge laterally into steep low hills not more than 100 feet high. Most of plain is probably a few feet in altitude; locally higher at the Tubig River where altitude is 40 feet and at Paninihian Point where altitude is 25 feet. Several important rivers cross the plain. A broad sandy beach lies north and south of the Soribao River; a smaller beach borders Port Borongan. Narrow sand beaches at heads of most bays; mangrove swamps at head of Napla Bay. Many parts of shore bordered by short stretches of swamp. Throughout most of the area, a narrow band of rough, steep, hills, 100 to 400 feet high, lies between the plain and the interior mountains.	Low sandy coastal ridge commonly planted to coconuts; rice paddies are common in the lower poorly drained parts of the plain. Coconuts and abaca are planted on the hill sides in some parts, but forest or cogon grass are probably more common. The small islands are low, some only a few feet above sea level; partly wooded, partly covered by coconuts. Macalayo Island is entirely mangrove, Catalaban has swamp in central portion. Footing good on the sandy coastal strips, poor in the rice paddies. On the hill slopes, ground is muddy and sticky when wet; footing poor.	First and second-class road follows coast. Vehicles can move off the road; can probably reach road from beaches. Unfordable rivers and rice paddies are chief obstacles. Borongan and Soribao Rivers can be navigated perhaps ten miles by boats drawing less than 6 feet of water, but bar at mouth of Soribao River prevents entrance.
4	In most of the area low dissected steep-sided or cliffed mountains reach the sea; 40 to 90-foot intermittent vertical cliffs north of Hernani. Rough terrain of cliffs and low mountains lies behind the rocky coast. On south coast of Samar high isolated hills, separated from the main spurs by low (less than 100 feet) narrow plains, form promontories on the south coast. Very limited coastal plains and beaches between mountains and sea, perhaps the most extensive at Balangiga.	Area generally heavily forested. Trees along cliffs north of Hernani are very stunted, scarcely more than brushy thickets. Coconuts grow on sandy coastal strips; rice grown in lowlands near rivers. Footing good in sandy coastal areas; poor in hilly areas that have deep sticky mud when wet.	Except for narrow coastal lowlands, area is almost impassable for vehicles without construction of roads. Narrow-gage railroad inland five miles from Pambujan Sur to iron mine. Second-class road south to Tanglad; first-class road across coastal plain from Balangiga to Giporlos. Cross-country movement for vehicles may be possible in small plains areas; unfordable rivers and rice paddies are obstacles. Foot troops may move along coast but terrain is very rough; heavy jungle and rivers are obstacles. Some rivers navigable for several miles by shallow-draft boats.
5	**Narrow neck between Matarinao and Quinapundan Bays is low lying. Low rough hills east of Quinapundan Bay merge into broad coastal plain at Cabarasan Point. Eastern boundary of hills is a narrow ridge (2,000 ft or less wide, 350-400 ft high) running the length of the peninsula and forming the islands to the south. East side of ridge exceedingly steep, locally vertical cliffs; west side steep slopes. Surface rough, deep holes, caverns, and needle points. Very narrow east coast plain fronted by alternating series of bluffs (20 ft high) and high sand beaches(storm level 8-10 ft); is joined to broad west coast plain by mile wide gap in ridge. Only unobstructed beach is 2 miles long in front of Guiuan.** Calicoan, Manicani, and Tubabao Islands at the south are continuations of the ridge; have very narrow coastal plains. Reefs between islands and peninsula are visible at low tide. Balinatio and Botic Islands are low, divided into areas of swamps and forests; some coconut palms. Tubabao Island has no swamps. Central portion of Manicani Island is high, altitude 534 feet, and wooded; coconut groves in coastal area. Numerous other small islands; some are entirely swampy; some have coconut palms; coral reefs exposed at low tide.	Large plains areas cultivated to coconuts, probably some cogon grass and wooded sections. Northern hilly area forested; ridge sparsely covered by stunted trees and shrubs. Footing good in sandy plains; poor in hilly area where ground may be muddy and sticky; very poor on ridge where there is thin cover of muddy sticky soil. Bare rock is exceedingly irregular and rough. Ground conditions on Calicoan, Manicani, and Tababao Islands similar to ridge.	Easy throughout the plains. First-class road from Guiuan to Salcedo; second-class road Salcedo to Santa Margarita. Jungle probably heavy between Matarinao and Quinapundan Bays. Jungle and steep slopes on hilly eastern parts of peninsula make vehicular movement impossible. Foot troops could probably use trails.
6	Long coastal plain which widens and merges with the broad river flats that extend several miles up the Basey River. Steep mountain slopes several miles inland. South of Sulug River a series of small fairly high, detached rounded or conical hills parallel the coast; some are undercut 15 to 20 feet at the shore. West of Basey River a rather high beach ridge (220 to 275 ft.) parallels the coast. Behind the beach ridge, and as far east as the Sulug River, the country is low, nearly flat and poorly drained in part. An area of low gullied hills, 300 to 400 feet high, with steep slopes probably lies between the lowland and the higher mountains. The Basey is only large river in the area; channel shifts locally; depth six feet or more; bottom is silty near shore.	Large areas of swamp in Basey Valley and in Capunluran Island; much low and poorly drained ground with many rice paddies; higher better drained country farther inland. Sandy areas along coast cultivated to coconuts. Plain from Sulug River south probably higher, better drained. Better-drained plains and lower hills in part cultivated to dry crops, coconuts and abaca, and in part covered with cogon grass or second-growth forest. Footing good in sandy coastal beaches or ridges; very poor in rice paddy areas and on the higher plains and hills when ground is wet.	Movement limited. Basey is on main west-coast road which connects by ferry with Leyte. In much of area cross-country movement probably feasible for vehicles and men in dry weather. Most rivers except Basey can be forded. Swamps and rice paddies are chief obstacles; in wet weather muddy ground hampers movement.
7	Coastal plains lacking except for a very narrow strip bordering Libtong Bay. Flanks of Mt. Danglay, highest point on coast, flatten within few miles to low broken steep-sided hills, 50 to 400 feet high, which extend throughout most of area. Low narrow plain extends from Libtong to Laguinit Bays; forms corridor between high rocky headland and interior hills and mountains.	Few miles inland from the coast the country is forested but closer to the coast there is some abaca; coconuts grown on well-drained hill slopes, rice in low poorly drained areas around the bay heads or rivers. Large mangrove swamps common, as at the head of Libtong Bay. Soil, clay loam; footing poor, especially in wet weather.	Second-class west-coast road touches at La Paz, for most part is in hilly country several miles inland. Cross-country movement probably impassible for vehicles. Foot troops can move with difficulty. Steep slopes, rice paddies, swamps and poor footing are chief obstacles.
8	Steep-sloped hilly islands with little or no flat land. Daram Island has some high rolling land in the north half; southern portion much more rugged; low narrow neck of land separates south and north halves.	Small part of islands forested; large areas in cogon grass, and remainder cultivated chiefly to coconuts; probably some abaca; perhaps a few rice paddies. Clay loam, soil; footing generally poor.	No roads or navigable rivers. Cross-country movement probably impossible for vehicles in most localities because of steep slopes. Foot troops could move fairly easily in dry weather though steep slopes and slippery cogon grass are minor obstacles. Poor footing, especially in wet weather.
9	Coastal plain backed by irregular steep-sided low hills. About 2 miles inland, between Buri and Calbiga Rivers , the hills merge into high ridges. Inland from Wright hills are more moderate; west of Wright and south of river near Pasigay, lowland is interrupted where hills reach the sea. Extensive swamps along coast at river mouths, and along rivers some distance inland especially on south side of Magueda Bay. At low tide shoals at mouths of all rivers make entrance of even bancas difficult. Calbiga River is largest and most important.	Large low-lying, poorly drained areas cultivated to rice; hills in part cultivated to abaca; however, for several miles inland from coast large areas are covered with cogon grass; few forested areas. Swamps largely mangrove and nipa. Soil muddy and sticky when wet; footing poor in rice paddies at all times, and on hills and higher parts of plain in wet weather.	First-class west-coast road passes through Wright; road to east coast often impassable. Cross-country movement of vehicles limited to better-drained parts of coastal plains. Foot troops can move anywhere but with difficulty. Steep slopes, numerous stream crossings, swamps, and slippery cogon grass are obstacles.
10	Steep hills and rocky cliffs lie at or near the coast along most of the area. Ridge, 1,575 feet high, parallels north side of Magueda Bay; is south of the small harbor of Catbalogan. North of Catbalogan, lower (300 to 500 feet) steep-sided, closely ravined hills reach the coast. From Catbalogan northward sea cliffs and rocky headlands are commonly 90 to 100 feet high; probably somewhat lower around Cambatutay Bay. Heads of bays are low; swamps follow inland a short distance along the river at Catbalogan; more extensive at the mouth and inland along the river at Cambatutay. Higher ridges back of low hills. Buri Island is low but hilly.	Higher ridges heavily forested. Low hills for several miles inland largely covered with cogon grass; some cultivated, chiefly to abaca, but in part to coconuts and dry crops. Very few rice paddies. A few sandy coastal strips cultivated to coconuts. Mangrove and nipa swamps. Bamboo fairly abundant.	**First-class west-coast road throughout area; mainly along shore but makes swing inland to Gandara. Cross-country movement for vehicles probably impossible; foot troops can move with difficulty in most places. Steep slopes are main obstacle; footing generally poor, especially when soil is wet.**
11	Differs throughout area: north to Santa Margarita, delta of the Gandara River forms a broad swampy area; from Santa Margarita to San Policarpo, sandy beach backed by rough irregular hills, 100 to 300 feet high as far as Carayman and by a plain beyond Carayman to San Policarpo. Swamps follow the river at Calbayog and lie in a broad arc across the plains between the town and the hills. Extensive swamps at the mouth of the Jibaton River north of San Policarpo. Steep-sided rough ridges, up to 875 feet in altitude, lie behind coastal hills and lowlands as far north as Calbayog; probably extend inland some distance. At Calbayog, ridges swing away from coast, leaving broad valley with a few moderately sloping low hills bordering west side of Jibatan and Oquendo Rivers; valley extends to north coast of Samar. Both the Jibatan and Gandara Rivers are broad and comparatively deep; have sandy or silty bottoms.	Extensive areas under cultivation; rice is grown in the low poorly drained plains between the swamps and along the rivers; coconuts on the sandy higher better-drained sections along the coast or rivers; abaca in the hilly areas and on the ridges for several miles inland from the coast. Hilly areas largely covered with cogon grass. On the few sandy sections, footing is good. Rice paddies are muddy and sticky. In the hilly areas and plains, the soil is muddy and sticky when wet and footing generally is poor.	Coastal road turns inland up the Jibatan River valley to north coast; becomes second-class. Cross-country movement for motorized units probably possible during dry weather in vicinity of Calbayog and plains east of Jibatan River; deep mud is serious obstacle in wet weather. Steep slopes of bordering hills, swamps, and numerous small streams are obstacles. Foot troops can operate throughout the area. Gandara River can be navigated by boats of 7-foot draft for fifteen miles inland; the Jibatan by boats of 10-foot draft for five miles inland.

(continued)

SAMAR AND LEYTE(P.I.)

Map Unit	Topography
1	No coastal plains except small area at mouth c Pangpang Bay and Bunga Point. From Oacan Poir mountains rise aburptly from shore. In vicini slopes are in part almost vertical; high-water boulders. South of Sila Point, coastal hills slopes; backed by higher mountains. Heads of
2	Coastal plain 1 to 3 miles wide connects the r Dolores, and Ulut Rivers. From south side of lowland restricted to a narrow band bordered b At Oras Bay sandy beach ridge fronts the lowla wide, extend southward from Cabra Point. Prin wide.
3	Narrow coastal plain; most extensive in vicini as between Borongan and the sea, the narrow co laterally into steep low hills not more than l is probably a few feet in altitude; locally hi altitude is 40 feet and at Paninihian Point whe Several important rivers cross the plain. A b and south of the Soribao River; a smaller beac Narrow sand beaches at heads of most bays; mar Napla Bay. Many parts of shore bordered by sh Throughout most of the area, a narrow band of 400 feet high, lies between the plain and the
4	In most of the area low dissected steep-sided the sea; 40 to 90-foot intermittent vertical c terrain of cliffs and low mountains lies behin coast of Samar high isolated hills, separated (less than 100 feet) narrow plains, form promo Very limited coastal plains and beaches betwee

[redacted]

SAMAR TERRAIN

Reliability: Good

	Ground Conditions
of Gamay River; beaches between nt to Sila Point, precipitous ity of Cape Espiritu Santo, r line is bordered by heaped are lower; have more moderate bays generally muddy.	Hills and mountains heavily forested. S Point swamps border many parts of coast; inland a mile or two along the rivers. loam. Footing poor.
river plains of the Oras, Oras Bay to Cabra Point, by low steep-sided hills. and. Beaches, 30 to 60 feet acipal rivers are deep and	Low area behind beach ridge at Oras Bay swampy. Behind beach south of Cabra Poi is grassy or covered by coconut groves w undergrowth. Low poorly drained areas a rivers cultivated to rice, hills for mos heavily wooded; locally overgrown with c Footing good along beach ridge, but in p ground is muddy and sticky when wet. Ri provide poor footing at all times.
ity of Soribao River. Locally oastal plain may merge 100 feet high. Most of plain igher at the Tubig River where ere altitude is 25 feet. broad sandy beach lies north ch borders Port Borongan. ngrove swamps at head of nort stretches of swamp. rough, steep, hills, 100 to interior mountains.	Low sandy coastal ridge commonly planted rice paddies are common in the lower poo parts of the plain. Coconuts and abaca on the hill sides in some parts, but for cogon grass are probably more common. T islands are low, some only a few feet ab level; partly wooded, partly covered by Macalayo Island is entirely mangrove, Ca swamp in central portion. Footing good sandy coastal strips, poor in the rice p the hill slopes, ground is muddy and sti wet; footing poor.
or cliffed mountains reach cliffs north of Hernani. Rough nd the rocky coast. On south from the main spurs by low ontories on the south coast. en mountains and sea, perhaps	Area generally heavily forested. Trees north of Hernani are very stunted, scarc than brushy thickets. Coconuts grow on strips; rice grown in lowlands near rive good in sandy coastal areas; poor in hil that have deep sticky mud when wet.

APPRECIATION : COASTAL DETAIL

	Movement
South of Sila extend Soil is clay	No roads. One trail and navigable river. Movement impossible for vehicles and very difficult for men. Heavy jungle and steep slopes are obstacles.
may be int, plain with bushy along the st part cogon grass. plains ice paddies	Second-class road southward from Oras. Vehicles probably could operate off the road when plains dry; beaches can be used at any time. Deep unfordable rivers, rice paddies, and swamps are obstacles. Dolores and Oras Rivers can be entered and navigated by boats drawing up to 6 feet of water. Mouth of Ulut River very dangerous for launches, but river is navigable for some distance above mouth.
d to coconuts; orly drained are planted rest or The small bove sea coconuts. atalaban has on the paddies. On icky when	First and second-class road follows coast. Vehicles can move off the road; can probably reach road from beaches. Unfordable rivers and rice paddies are chief obstacles. Borongan and Soribao Rivers can be navigated perhaps ten miles by boats drawing less than 6 feet of water, but bar at mouth of Soribao River prevents entrance.
along cliffs cely more sandy coastal ers. Footing ly areas	Except for narrow coastal lowlands, area is almost impassable for vehicles without construction of roads. Narrow-gage railroad inland five miles from Pambujan Sur to iron mine. Second-class road south to Tanglad;

	the most extensive at Balangiga.
5	Narrow neck between Matarinao and Quinapundan rough hills east of Quinapundan Bay merge into Cabarasan Point. Eastern boundary of hills is or less wide, 350-400 ft high) running the len forming the islands to the south. East side o locally vertical cliffs; west side steep slope holes, caverns, and needle points. Very narro by alternating series of bluffs (20 ft high) a level 8-10 ft); is joined to broad west coast ridge. Only unobstructed beach is 2 miles lon Calicoan, Manicani, and Tubabao Islands at the the ridge; have very narrow coastal plains. islands and peninsula are visible at low tide. are low, divided into areas of swamps and fore Tubabao Island has no swamps. Central portion altitude 534 feet, and wooded; coconut groves other small islands; some are entirely swampy; coral reefs exposed at low tide.
6	Long coastal plain which widens and merges wit extend several miles up the Basey River. Stee miles inland. South of Sulug River a series o rounded or conical hills parallel the coast; s feet at the shore. West of Basey River a rath 275 ft.) parallels the coast. Behind the beac the Sulug River, the country is low, nearly fl An area of low gullied hills, 300 to 400 feet probably lies between the lowland and the high only large river in the area; channel shifts l more; bottom is silty near shore.
7	Coastal plains lacking except for a very narro Flanks of Mt. Danglay, highest point on coast, low broken steep-sided hills, 50 to 400 feet h most of area. Low narrow plain extends from I corridor between high rocky headland and inter

mountains and sea, perhaps	that have deep sticky mud when wet.
Bays is low lying. Low broad coastal plain at a narrow ridge (2,000 ft gth of the peninsula and f ridge exceedingly steep, s. Surface rough, deep w east coast plain fronted nd high sand beaches(storm plain by mile wide gap in g in front of Guiuan. e south are continuations of Reefs between Balinatio and Botic Islands sts; some coconut palms. of Manicani Island is high, in coastal area. Numerous some have coconut palms;	Large plains areas cultivated to coconut some cogon grass and wooded sections. N hilly area forested; ridge sparsely cove stunted trees and shrubs. Footing good plains; poor in hilly area where ground muddy and sticky; very poor on ridge whe thin cover of muddy sticky soil. Bare r exceedingly irregular and rough. Ground on Calicoan, Manicani, and Tababao Islan to ridge.
h the broad river flats that p mountain slopes several f small fairly high, detached ome are undercut 15 to 20 er high beach ridge (220 to h ridge, and as far east as at and poorly drained in part. high, with steep slopes er mountains. The Basey is ocally; depth six feet or	Large areas of swamp in Basey Valley and Capunluran Island; much low and poorly d ground with many rice paddies; higher be country farther inland. Sandy areas alo cultivated to coconuts. Plain from Sulu south probably higher, better drained. drained plains and lower hills in part c to dry crops, coconuts and abaca, and in covered with cogon grass or second-growt Footing good in sandy coastal beaches or very poor in rice paddy areas and on the plains and hills when ground is wet.
w strip bordering Libtong Bay. flatten within few miles to igh, which extend throughout Libtong to Laguinit Bays; forms rior hills and mountains.	Few miles inland from the coast the coun forested but closer to the coast there i abaca; coconuts grown on well-drained hi rice in low poorly drained areas around heads or rivers. Large mangrove swamps at the head of Libtong Bay. Soil, clay

	First-class road across coastal plain from Balangiga to Giporlos. Cross-country movement for vehicles may be possible in small plains areas; unfordable rivers and rice paddies are obstacles. Foot troops may move along coast but terrain is very rough; heavy jungle and rivers are obstacles. Some rivers navigable for several miles by shallow-draft boats.
s, probably Northern ered by in sandy may be ere there is rock is conditions ds similar	Easy throughout the plains. First-class road from Guiuan to Salcedo; second-class road Salcedo to Santa Margarita. Jungle probably heavy between Matarinao and Quinapundan Bays. Jungle and steep slopes on hilly eastern parts of peninsula make vehicular movement impossible. Foot troops could probably use trails.
in rained etter drained ng coast g River Better- ultivated part h forest. ridges; higher	Movement limited. Basey is on main west-coast road which connects by ferry with Leyte. In much of area cross-country movement probably feasible for vehicles and men in dry weather. Most rivers except Basey can be forded. Swamps and rice paddies are chief obstacles; in wet weather muddy ground hampers movement.
try is s some ll slopes, the bay common, as loam; footing	Second-class west-coast road touches at La Paz, for most part is in hilly country several miles inland. Cross-country movement probably impassible for vehicles. Foot troops can move with difficulty. Steep slopes, rice paddies, swamps and poor footing are chief

8	Steep-sloped hilly islands with little or no f some high rolling land in the north half; sout rugged; low narrow neck of land separates sout
9	Coastal plain backed by irregular steep-sided inland, between Buri and Calbiga Rivers , th Inland from Wright hills are more moderate; we river near Pasigay, lowland is interrupted wher tensive swamps along coast at river mouths, an inland especially on south side of Magueda Bay mouths of all rivers make entrance of even bar is largest and most important.
10	Steep hills and rocky cliffs lie at or near th Ridge, 1,575 feet high, parallels north side o small harbor of Catbalogan. North of Catbalog steep-sided, closely ravined hills reach the c ward sea cliffs and rocky headlands are common probably somewhat lower around Cambatutay Bay. swamps follow inland a short distance along th extensive at the mouth and inland along the ri ridges back of low hills. Buri Island is low
11	Differs throughout area: north to Santa Margar River forms a broad swampy area; from Santa Ma sandy beach backed by rough irregular hills, l Carayman and by a plain beyond Carayman to San the river at Calbayog and lie in a broad arc a town and the hills. Extensive swamps at the m north of San Policarpo. Steep-sided rough rid altitude, lie behind coastal hills and lowland probably extend inland some distance. At Calb coast, leaving broad valley with a few moderat bordering west side of Jibatan and Oquendo Riv coast of Samar. Both the Jibatan and Gandara comparatively deep; have sandy or silty bottom

	poor, especially in wet weather.
lat land. Daram Island has hern portion much more h and north halves.	Small part of islands forested; large ar grass, and remainder cultivated chiefly probably some abaca; perhaps a few rice Clay loam, soil; footing generally poor.
low hills. About 2 miles e hills merge into high ridges. st of Wright and south of e hills reach the sea. Ex- d along rivers some distance . At low tide shoals at cas difficult. Calbiga River	Large low-lying, poorly drained areas cul rice; hills in part cultivated to abaca; for several miles inland from coast larg covered with cogon grass; few forested a Swamps largely mangrove and nipa. Soil sticky when wet; footing poor in rice pa all times, and on hills and higher parts wet weather.
e coast along most of the area. f Magueda Bay; is south of the an, lower (300 to 500 feet) oast. From Catbalogan north- ly 90 to 100 feet high; Heads of bays are low; e river at Catbalogah; more ver at Cambatutay. Higher but hilly.	Higher ridges heavily forested. Low hil several miles inland largely covered wit some cultivated, chiefly to abaca, but i coconuts and dry crops. Very few rice p few sandy coastal strips cultivated to c Mangrove and nipa swamps. Bamboo fairly
ita, delta of the Gandara rgarita to San Policarpo, 00 to 300 feet high as far as Policarpo. Swamps follow cross the plains between the outh of the Jibaton River ges, up to 875 feet in s as far north as Calbayog; ayog, ridges swing away from ely sloping low hills ers; valley extends to north Rivers are broad and s.	Extensive areas under cultivation; rice the low poorly drained plains between th along the rivers; coconuts on the sandy drained sections along the coast or rive in the hilly areas and on the ridges for miles inland from the coast. Hilly area covered with cogon grass. On the few sa footing is good. Rice paddies are muddy In the hilly areas and plains, the soil sticky when wet and footing generally is

	obstacles.
reas in cogon to coconuts; paddies.	No roads or navigable rivers. Cross-country movement probably impossible for vehicles in most localities because of steep slopes. Foot troops could move fairly easily in dry weather though steep slopes and slippery cogon grass are minor obstacles. Poor footing, especially in wet weather.
tivated to however, e areas are reas. muddy and ddies at of plain in	First-class west-coast road passes through Wright; road to east coast often impassable. Cross-country movement of vehicles limited to better-drained parts of coastal plains. Foot troops can move anywhere but with difficulty. Steep slopes, numerous stream crossings, swamps, and slippery cogon grass are obstacles.
ls for h cogon grass; n part to addies. A oconuts. abundant.	First-class west-coast road throughout area; mainly along shore but makes swing inland to Gandara. Cross-country movement for vehicles probably impossible; foot troops can move with difficulty in most places. Steep slopes are main obstacle; footing generally poor, especially when soil is wet.
is grown in e swamps and higher better- rs; abaca several s largely ndy sections, and sticky. is muddy and poor.	Coastal road turns inland up the Jibatan River valley to north coast; becomes second-class. Cross-country movement for motorized units probably possible during dry weather in vicinity of Calbayog and plains east of Jibatan River; deep mud is serious obstacle in wet weather. Steep slopes of bordering hills, swamps, and numerous small streams are obstacles. Foot troops can operate throughout the area. Gandara River can be navigated by boats of 7-foot draft for fifteen miles inland; the Jibatan by boats of 10-foot draft for five miles inland.

(continued)

SAMAR AND LEYTE (P.I.)

SAMAR TERRAIN APPRECIATION: COASTAL DETAIL

Map Unit	Topography	Ground Conditions	Movement
12	High mountains border the coast in places, terminating in shore cliffs. Slopes extremely steep; cut by numerous small ravines. Narrow coastal flat extends several miles northward from the Mauo River and northward from Looc Point. Elsewhere small flats occur only at the mouths of streams; are separated by rough headlands. Beaches are numerous but very small; marked by location of villages; only ones of importance are north and south of Burobodiongan Point and to the north of Looc Point. Several streams in the area are fairly large and deep, with moderate current and silty or sandy bottoms near mouths, but swift with numerous rapids and falls a few miles upstream. The north end of Dalupiri Island is low and rolling with some swamps; low highly dissected hills in southern part; coast is low and sandy. Capul Island is much higher, maximum elevation is 710 feet; most of island is rough and hilly. Central valley runs from swamps at San Luis with low highly dissected ridge on the west and isolated hills on the east. Unobstructed beach west of town of Capul and at heads of coves on rocky west coast.	Mountains heavily forested. River flats intensively cultivated to rice in the lower poorly drained areas. Coconuts grown on the sandy beaches and possibly on the lowest slopes of the mountain. Most of area has clay-loam soil which is muddy and sticky when wet. Footing poor except in sandy sections.	Second-class road from Mauo to Allen and first-class road from Allen cuts inland across the hills to the north coast. A foot trail extends along the coast; and several trails connect with the Catarman-Calbayog Road. Cross-country movement impossible for vehicles; difficult for foot troops. Heavy jungle, steep slopes, deep rivers, and poor footing are obstacles. Due to rocks and falls, rivers navigable only by bancas.
13	Coastal plain bordered by mangrove swamps; locally interrupted by scattered isolated hills less than 200 feet high, or by mountain spurs which reach the sea. Plain is low and nearly flat; most parts are swampy; back of it, the interior mountains rise abruptly. Islands off-shore are low but hilly, maximum altitude is about 300 feet; all except Biri have extensive swamps.	Some low hills are cultivated to coconuts; in general both mainland and islands are covered with mangrove swamp or forest that is in part second growth. Clay soil throughout, footing poor at all times in swamp areas; in hilly sections poor only when ground is wet.	First-class road follows coast between swamps and mountains. Cross-country movement difficult for vehicles and foot troops. Extensive swamps are main obstacle.
14	Coastal plain extends from hills west of Bobon Point to northeast corner of Samar. Lowlands are generally two to three miles wide. Maximum widths in area occur opposite Bobon Point and around lower courses of rivers. Strip west of Mondragon River is the place where plain is narrowest. Coastal lowlands extend few miles up rivers; merge with the river plains. Plain generally flat or gently rolling. Narrow ridge 1/2 mile long parallels coast east of Bobon Point; another ridge rises above plain on east side of the Catarman River. For most part, shore bordered by sand beaches; some short stretches of mangrove, most extensive at mouth of the Catubig where swamps extends several miles inland. Narrow reefs common along parts of shore. Inland margin of plains bordered by range of rough hills, 300 to more than 500 feet high. Numerous large rivers cross the lowland. Most have clear channels with several feet of water for many miles inland. Most of the islands are low plains with some low hilly areas. Coasts bordered in part by beaches, in part by rocky bluffs, and in a few places by coral reefs. Laoang and Batag Islands are hilly; some mangrove swamps along south coasts. Channel between Daransan (chiefly mangrove swamp) and Laoang Islands is bared at low tide as is much of the bay between Laoang Island and Samar.	Away from the coast, the ridges are heavily forested; along the shore cogon grass is common and coconuts are grown extensively; locally forest extends to coast. In river valleys rice paddies are widespread. A wide grassy plain extends between Bantayan Bay and the forests. In the sandy coastal areas footing is good; in the rice paddy districts, very poor; in the clay soils of the plains, footing poor where ground is wet.	First-class coastal road from Catarman to Laoang, second-class road connects Catarman with Calbayog on west coast and Laoang with Catubig. Detours possible throughout area; cross-country movement possible in much of area in drier weather. Many deep rivers, some swampy areas, rice paddies, and forest are obstacles. Unfordable rivers are main obstacle for foot troops. Catubig River navigable for boats of ten-foot draft; Catarman and probably others, for shallow draft boats (5 to 6 feet); bancas usable in many streams.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

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SAMAR TERRAIN

	Ground Conditions
nating in shore cliffs. vines. Narrow coastal flat ver and northward from Looc mouths of streams; are ous but very small; marked are north and south of nt. Several streams in the rrent and silty or sandy ids and falls a few miles ow and rolling with some art; coast is low and evation is 710 feet; most ns from swamps at San Luis isolated hills on the east. heads of coves on rocky	Mountains heavily forested. River flats cultivated to rice in the lower poorly dr Coconuts grown on the sandy beaches and p the lowest slopes of the mountain. Most clay-loam soil which is muddy and sticky Footing poor except in sandy sections.
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APPRECIATION: COASTAL DETAIL

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mangrove swamp) and Laoang Islands is bared at
the bay between Laoang Island and Samar.

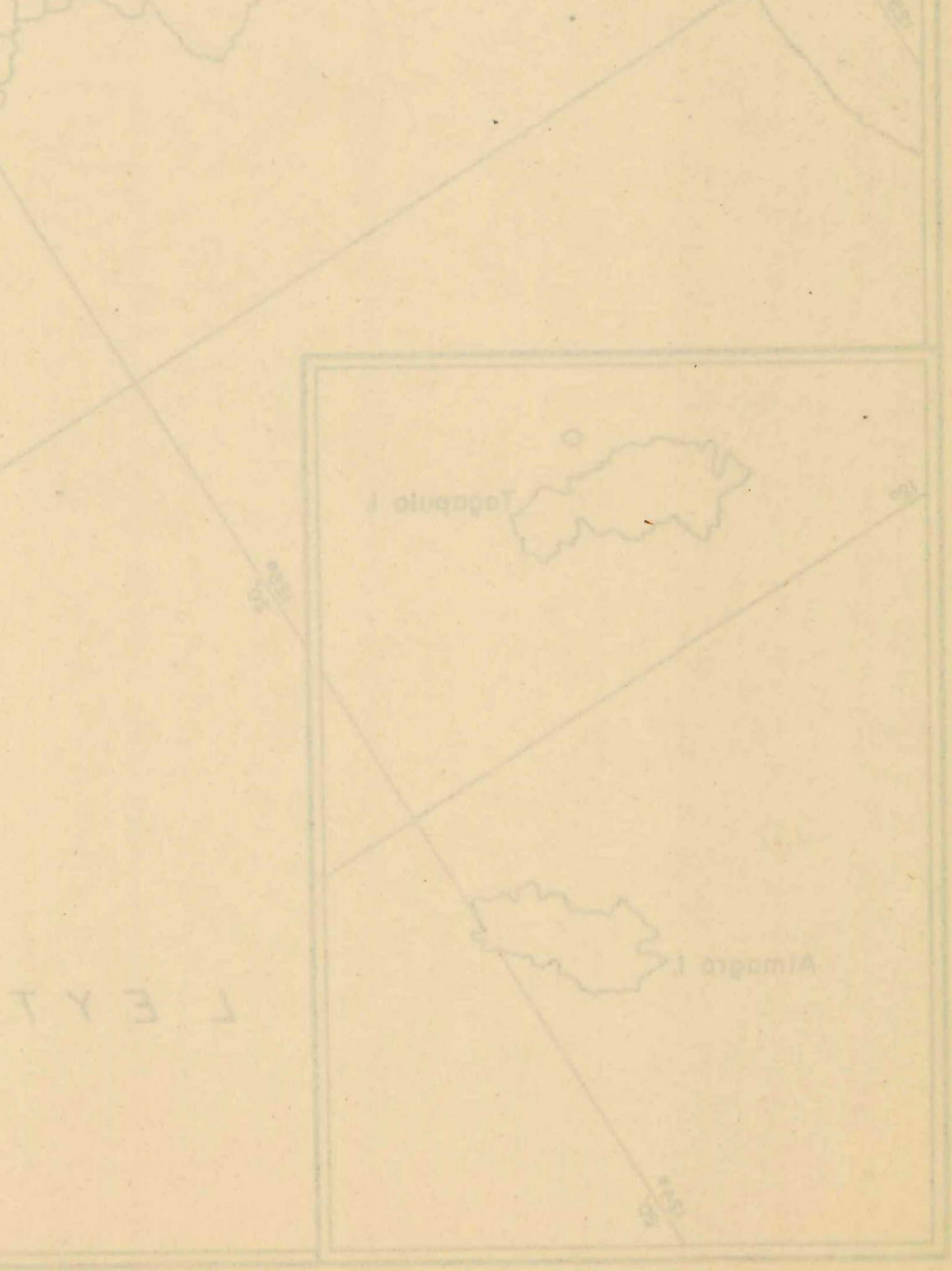
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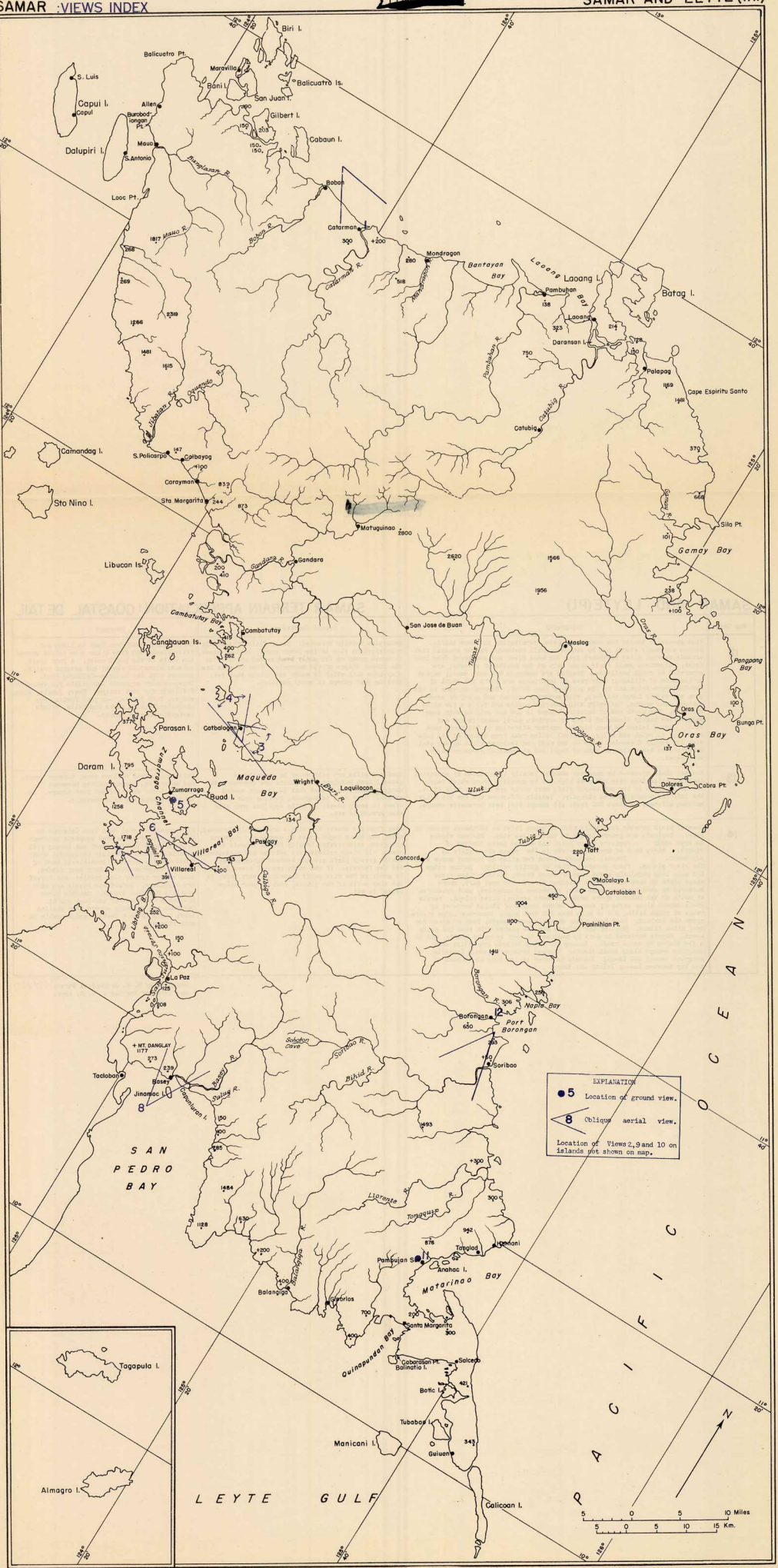
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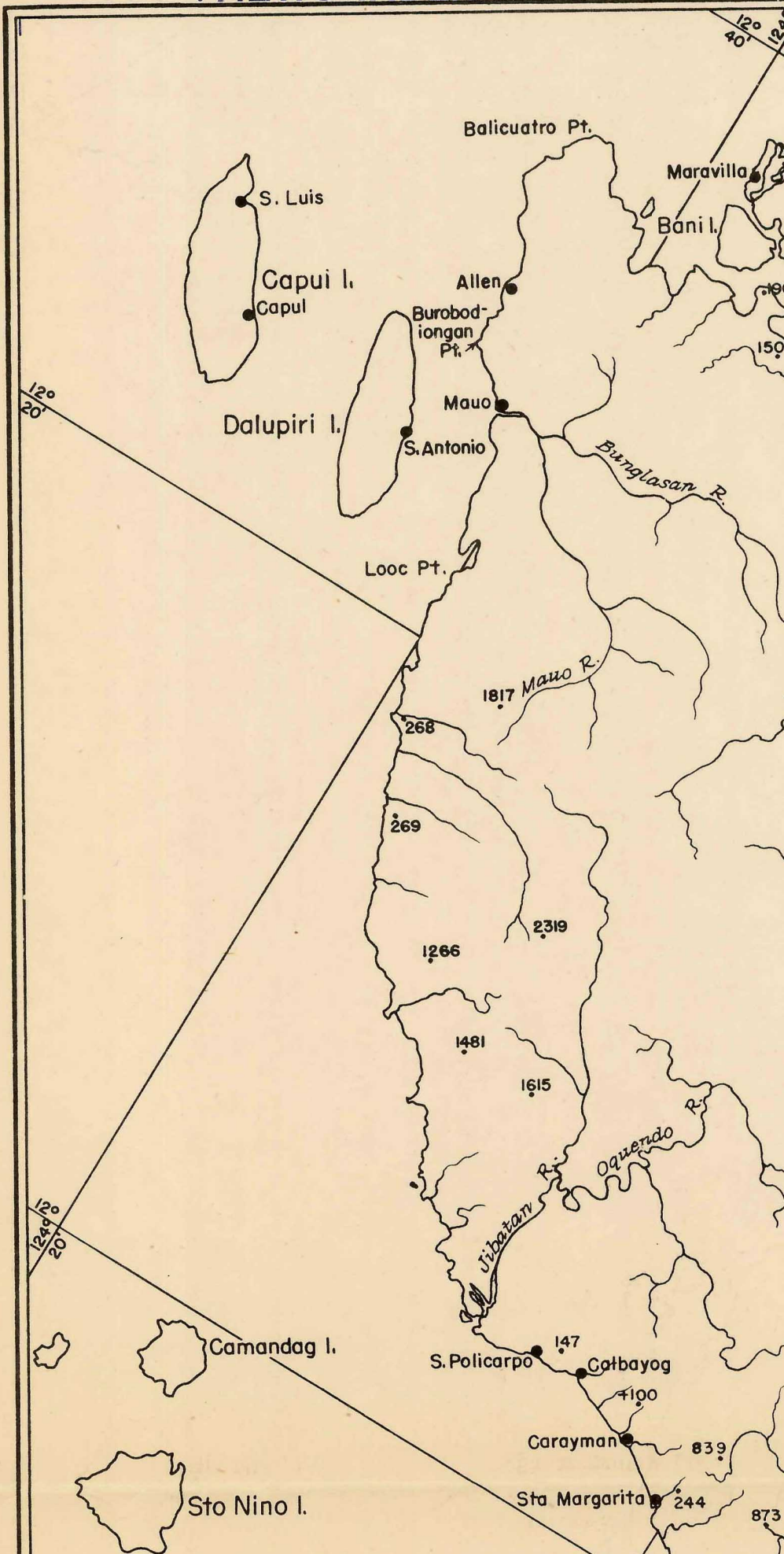


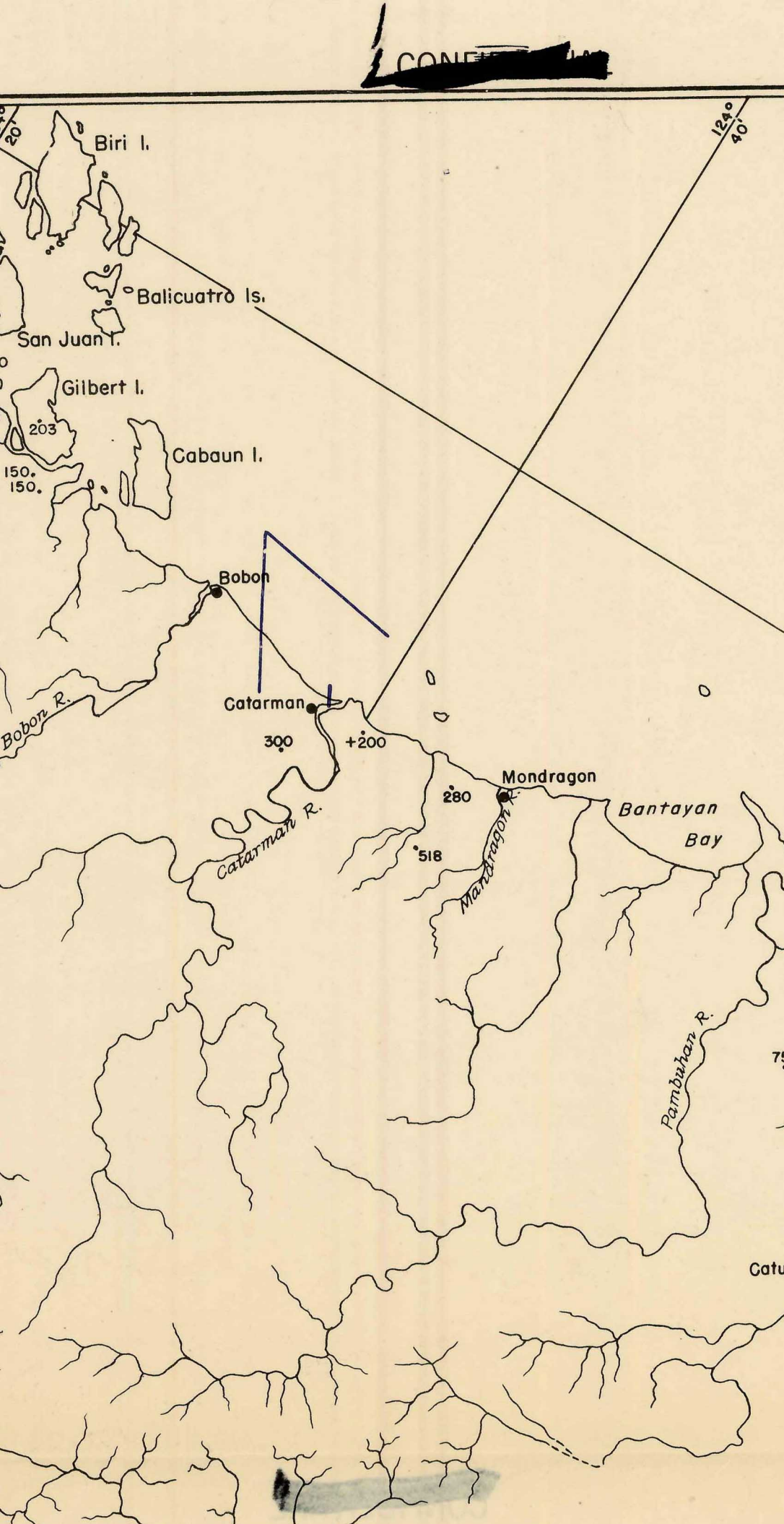




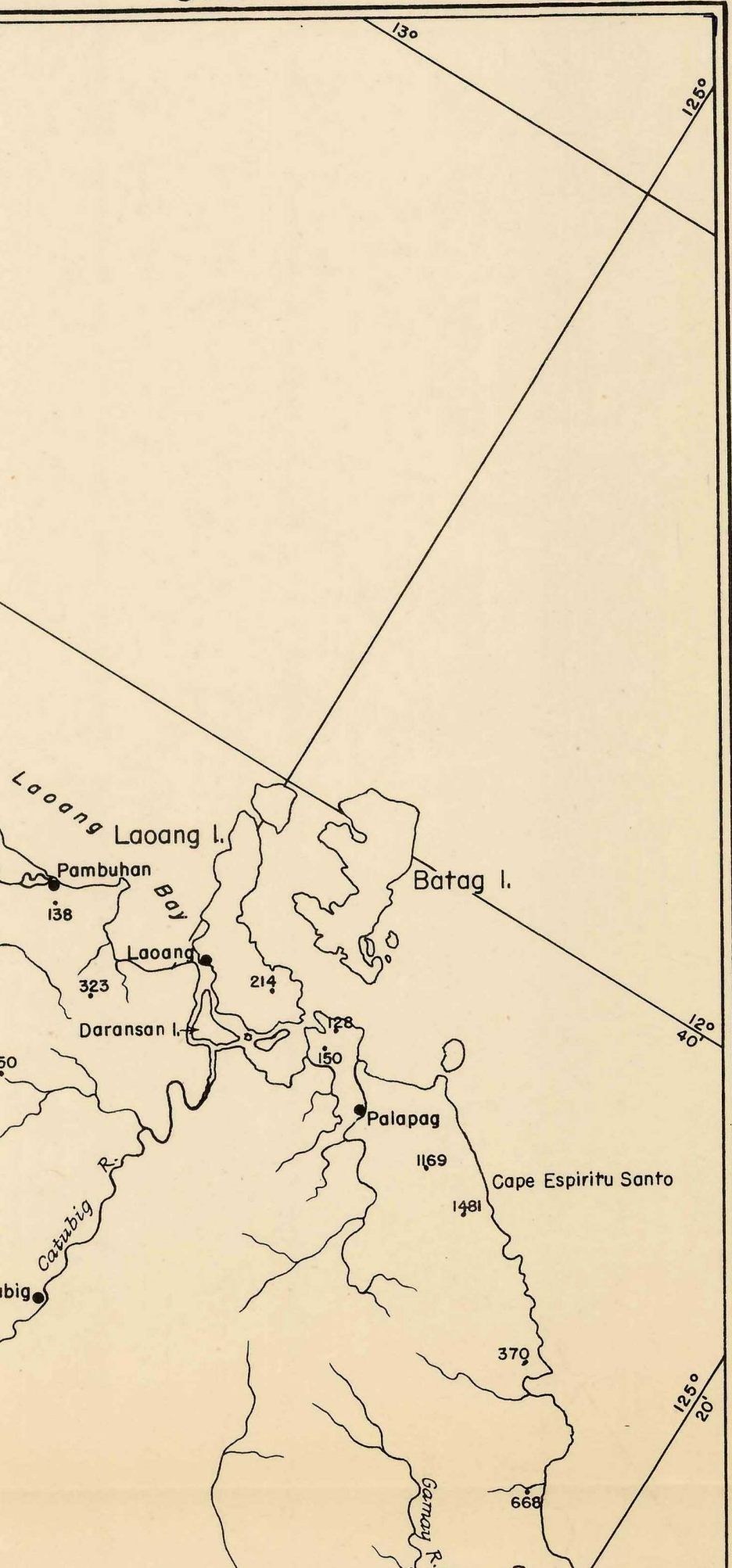
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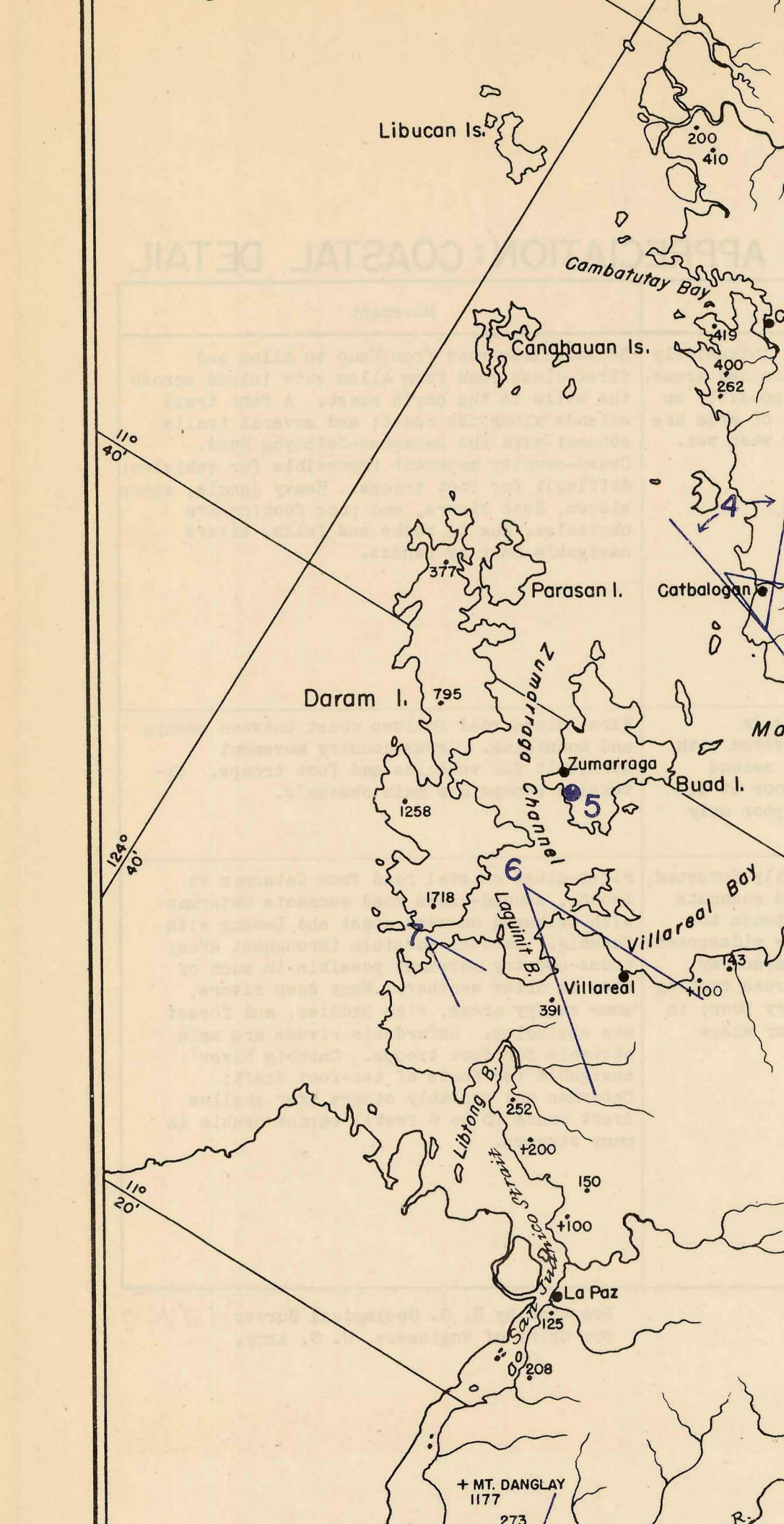
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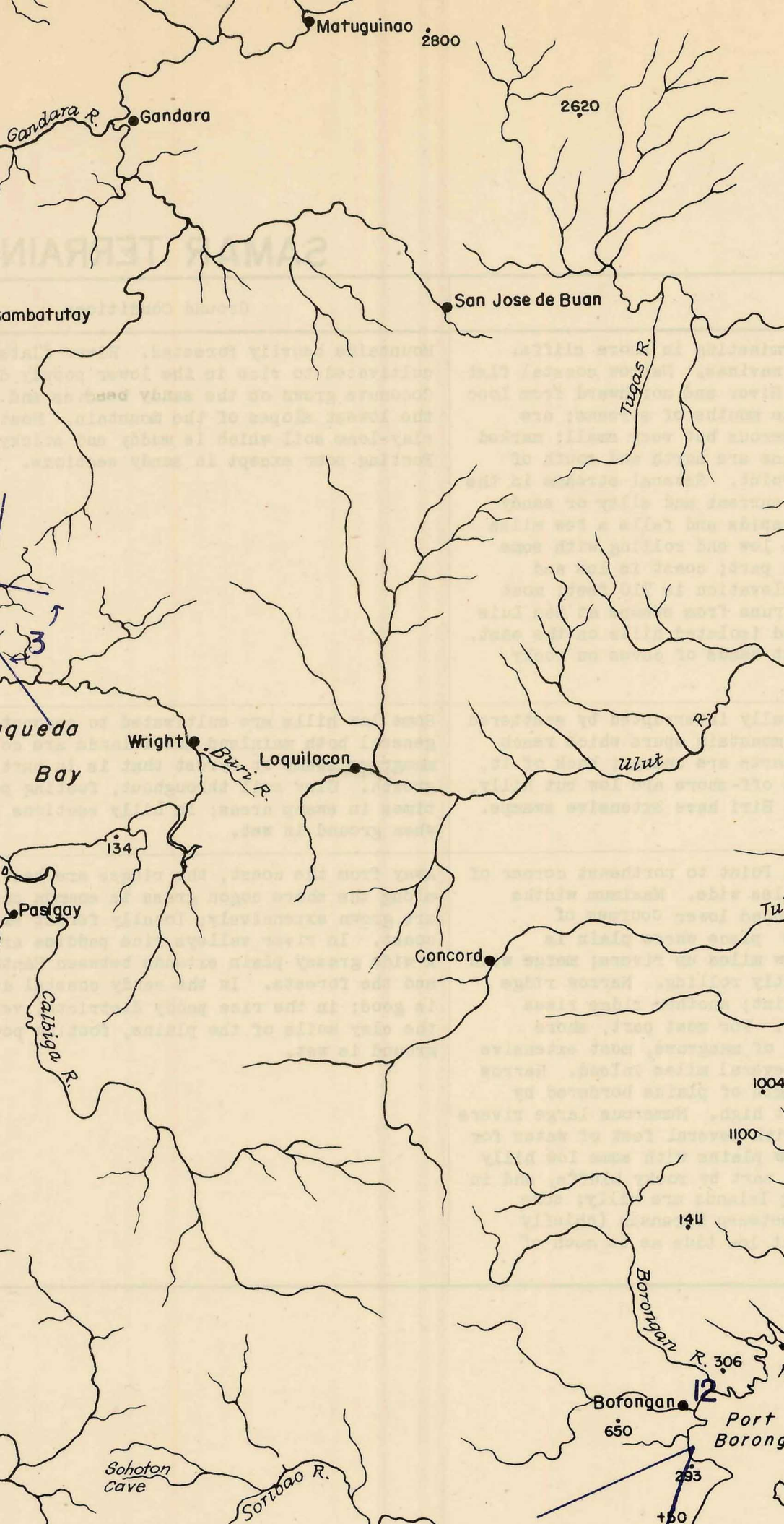


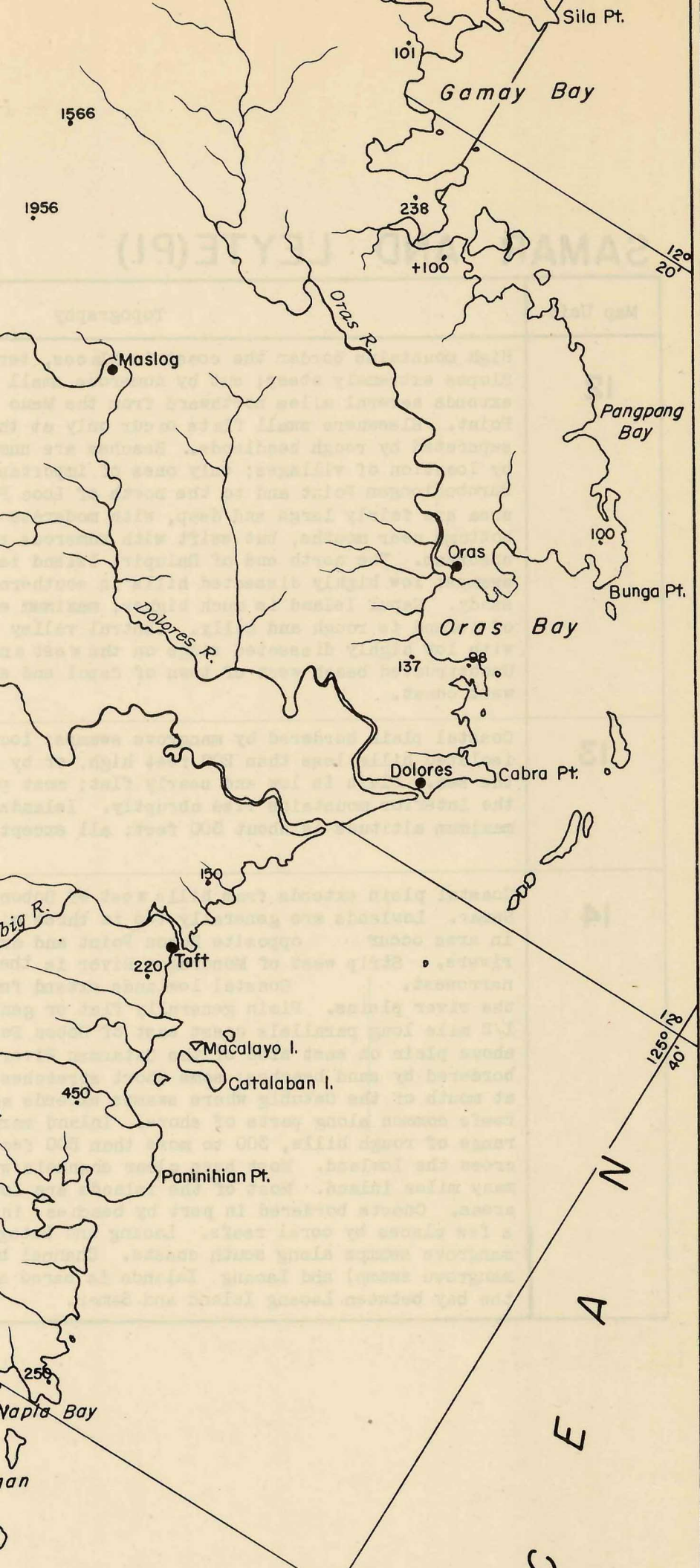

Biri I.
Balicuatro Is.
San Juan I.
Gilbert I.
203
Cabaun I.
150.
150.
Bobon
Bobon R.
Catarman
300
+200
Catarman R.
Mondragon
280
518
Mandragon R.
Bantayan
Bay
Pambuhan R.
124° 40'

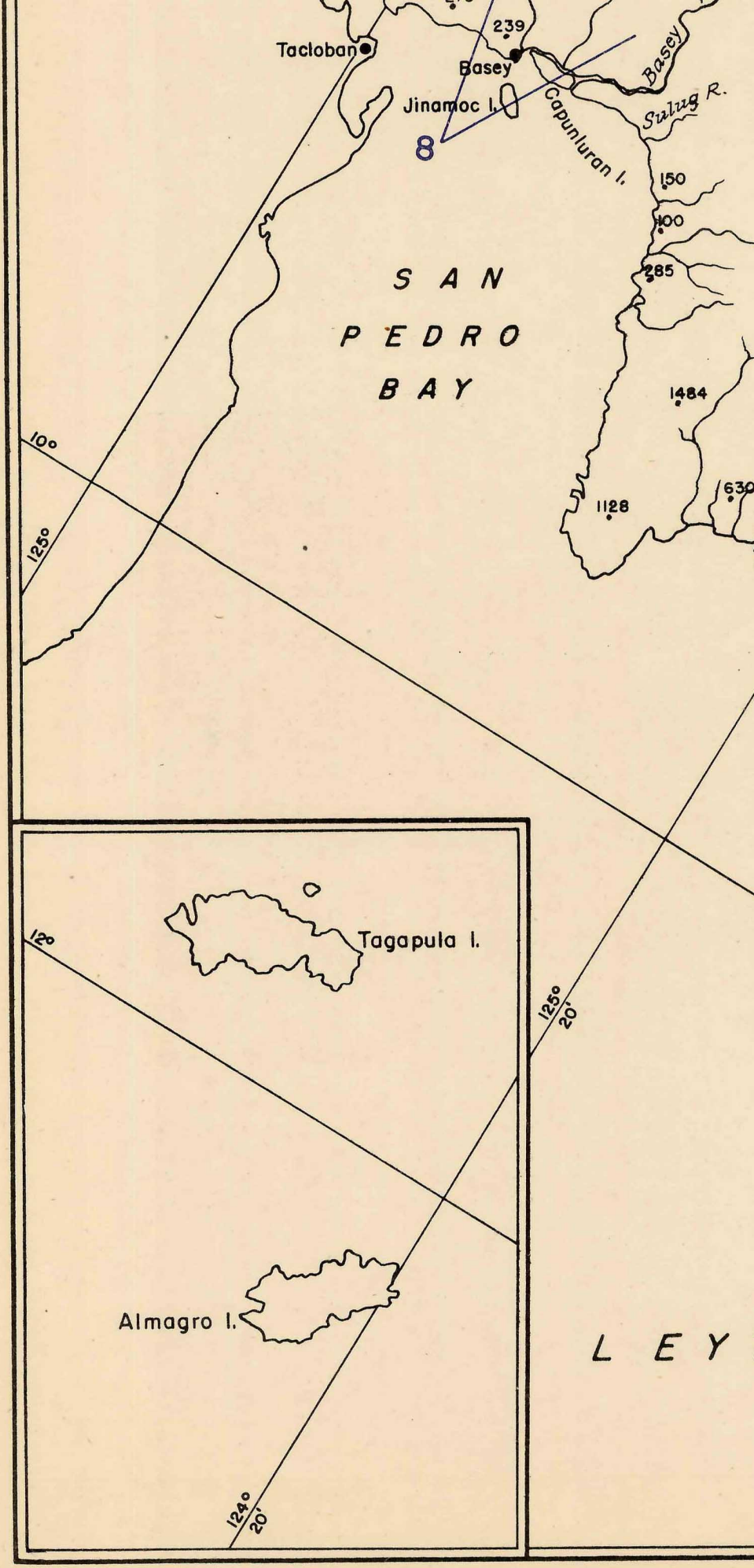
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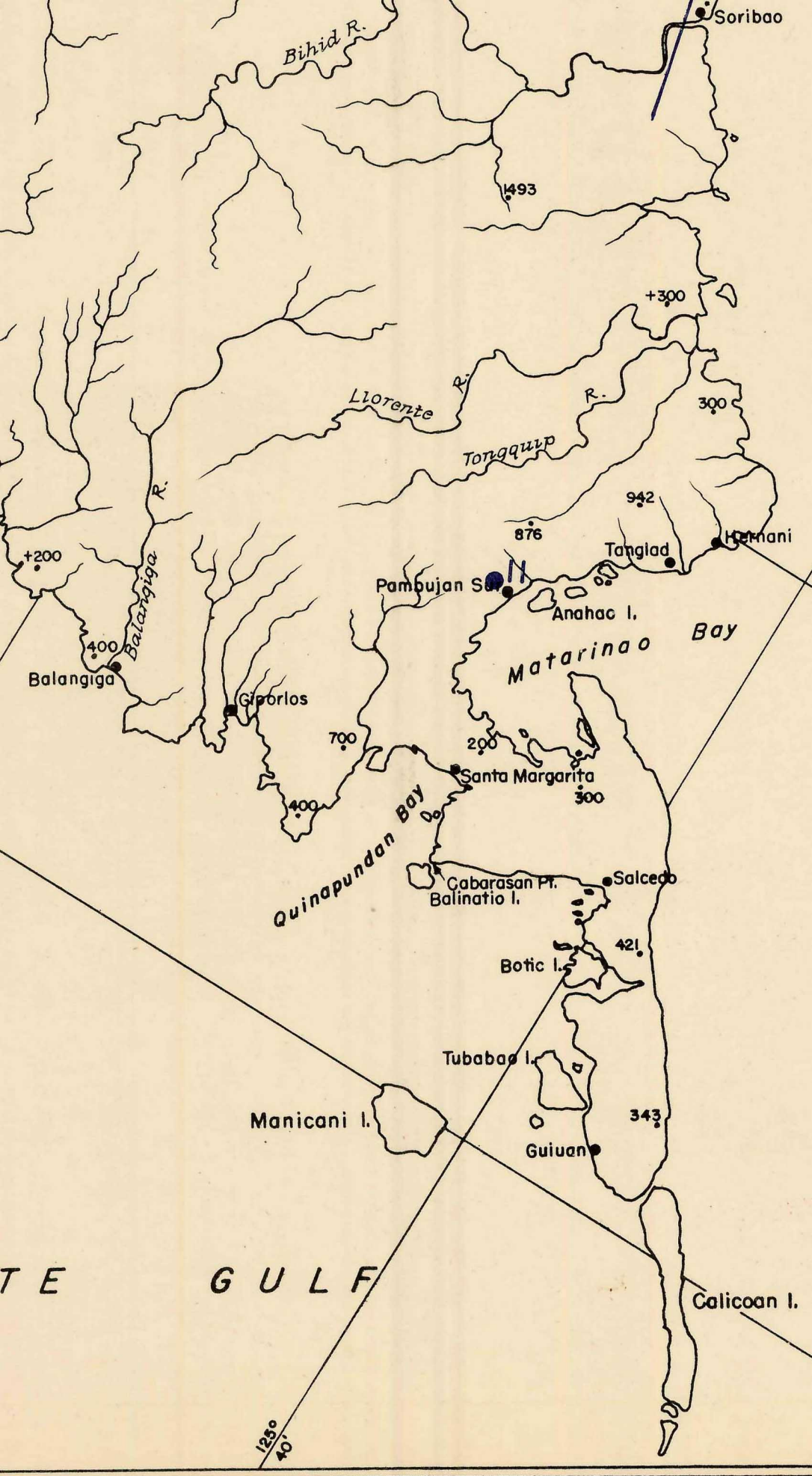


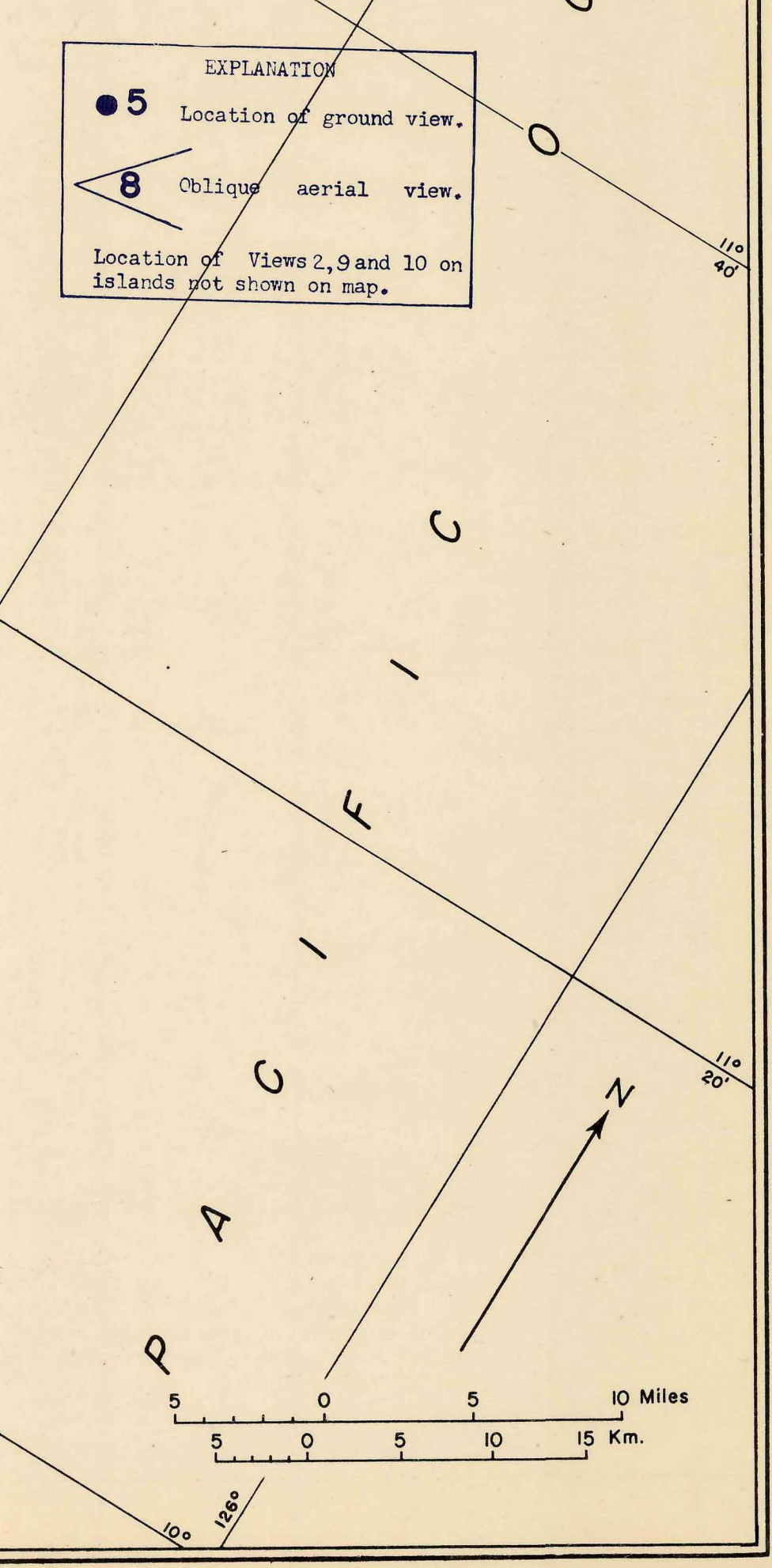

Libucan Is.
200
410
Cambatutay Bay
Canghauan Is.
419
400
262
110
40'
4
377
Parasan I.
Catbalogan
Daram I.
795
Zumarraga Channel
Zumarraga
Buad I.
5
1258
124°
40'
6
1718
7
Laguinit B.
Villareal Bay
143
Villareal
+100
391
Libtong B.
252
+200
150
+100
Carigara Strait
La Paz
125
208
110
20'
+ MT. DANGLAY
1177
273


Matuguinao
2800
Gandara R.
Gandara
2620
San Jose de Buan
Tugas R.
Wright
Burri R.
Loquilocon
Ulut R.
134
Pasigay
Concord
Calbiga R.
1004
1100
1411
Borongan R.
306
Borongan
650
Port
Sohoton cave
Soribao R.
293
+50


Sila Pt.
101
Gamay Bay
1566
1956
238
+100
120°
20'
Oras R.
Maslog
Pangpang Bay
100
Oras
Bunga Pt.
Dolores R.
Oras Bay
137
98
Dolores
Cabra Pt.
150
big R.
220
Taft
Macalayo I.
Catalaban I.
450
Paninihian Pt.
125°
40'
12
256
Wapia Bay
an
PACIFIC OCEAN


Tacloban
239
Basey
Basey
Sulug R.
Jinamoc I.
8
Capuniuran I.
150
100
285
SAN
PEDRO
BAY
1484
630
1128
10°
125°
Tagapula I.
12°
125°
20'
Almagro I.
L E Y
124°
20'

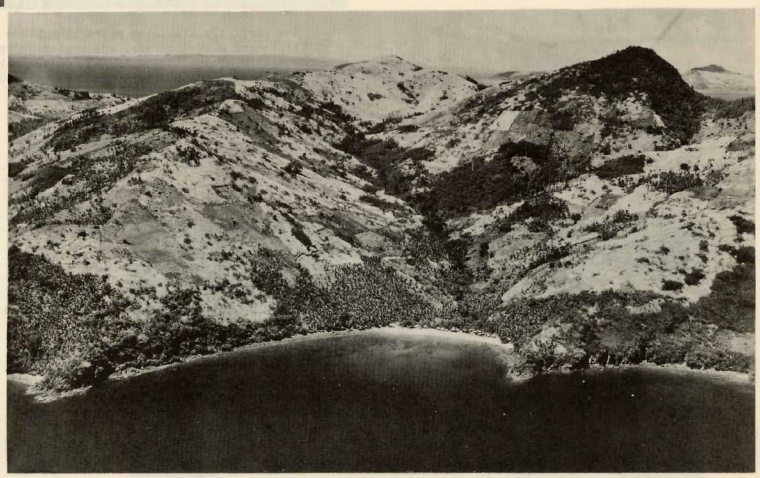

Soribao
Bihid R.
1493
+300
Llorente R.
Tongquip R.
300
942
876
Tanglad
Hermani
+200
Balangiga R.
Pambujan Sur
Anahac I.
Matarinao Bay
400
Balangiga
Giporlos
700
200
Santa Margarita
300
400
Quinapundan Bay
Cabarasan Pt.
Balinatio I.
Salcedo
421
Botic I.
Tubabao I.
Manicani I.
343
Guiuan
TE GULF
Calicoan I.
125°
40'



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1 Most of the extensive coastal lowlands on Samar Island are found along the north coast, and are backed by greatly dissected hills. In places, isolated groups of hills rise above the plain (right background). (20461 AC)



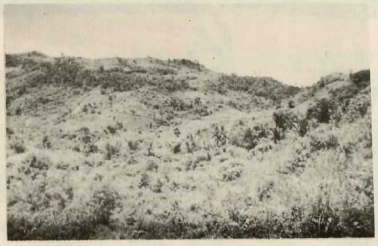
2 View of Almagro Island. Vegetation pattern typical of the deforested west coast of Samar. On the east coast hills and mountains are commonly wooded down to the shore. (1662626 AC)



3 Nearly all the lowlands on Samar are small like the one shown here and are surrounded by steep hills and mountains. Higher better-drained parts of lowlands are sites of towns and villages, and are partly under intensive cultivation. Broad belts of mangrove swamps along lower courses of rivers are useless except to supply some local needs for firewood; they are serious barriers to river crossings. (ONI 61968)



4 Small lowland on which Catbalogan, the principal town of Samar, is located; lowland is entirely surrounded by rugged hills, in part forested, in part grass covered. Automobile road from left foreground into the town has moderate to steep grades, numerous sharp curves and short tangents; it can be blocked in many places where detours are impossible and repairs difficult. (ONI 61989)



5 Cogon grass and brush on hills of northern Buad Island. This vegetation characteristic of areas cleared for cultivation and later abandoned. These slopes are more moderate than in most parts of Samar and Leyte or the adjacent islands. (ONI 315-034)

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SAMAR AND LEYTE (P.I.)



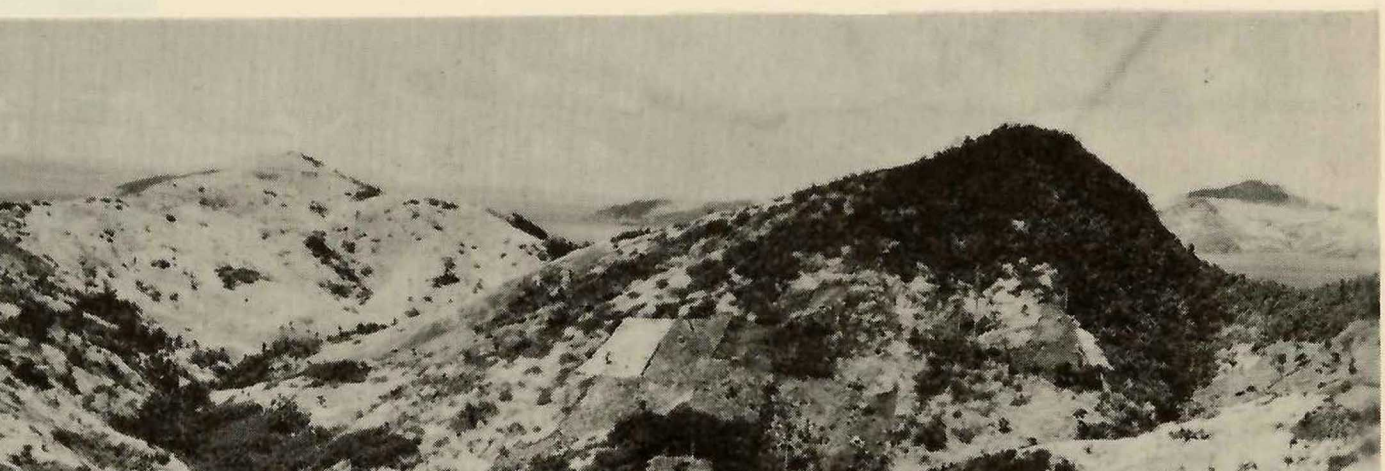
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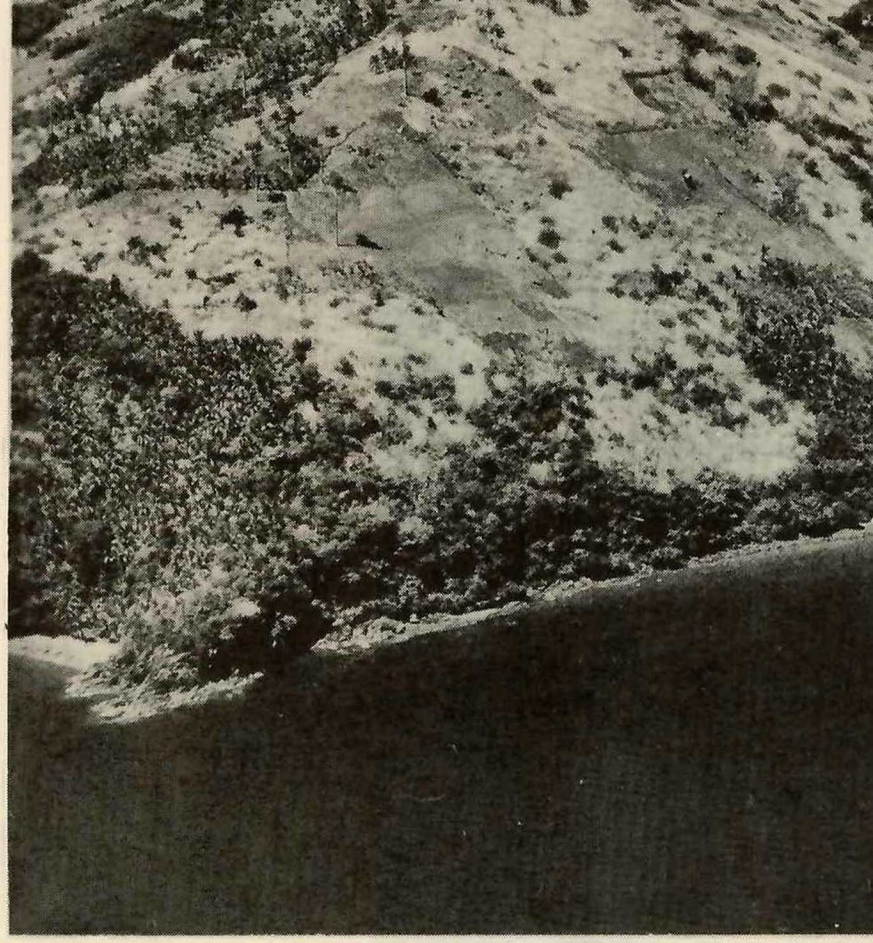


SAMAR VIEWS 1-5

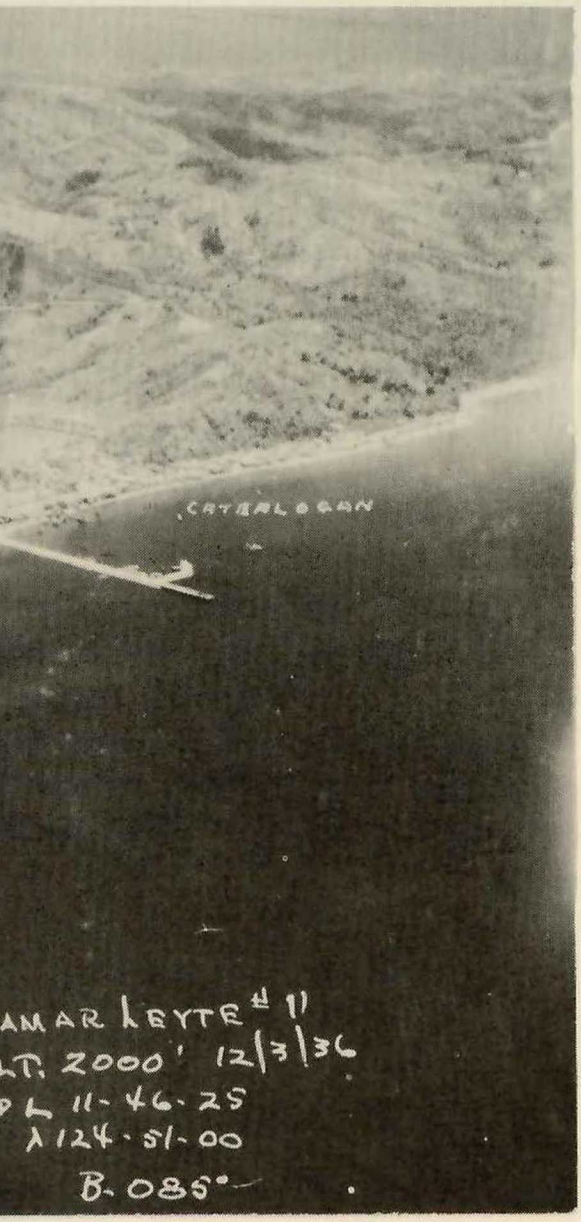




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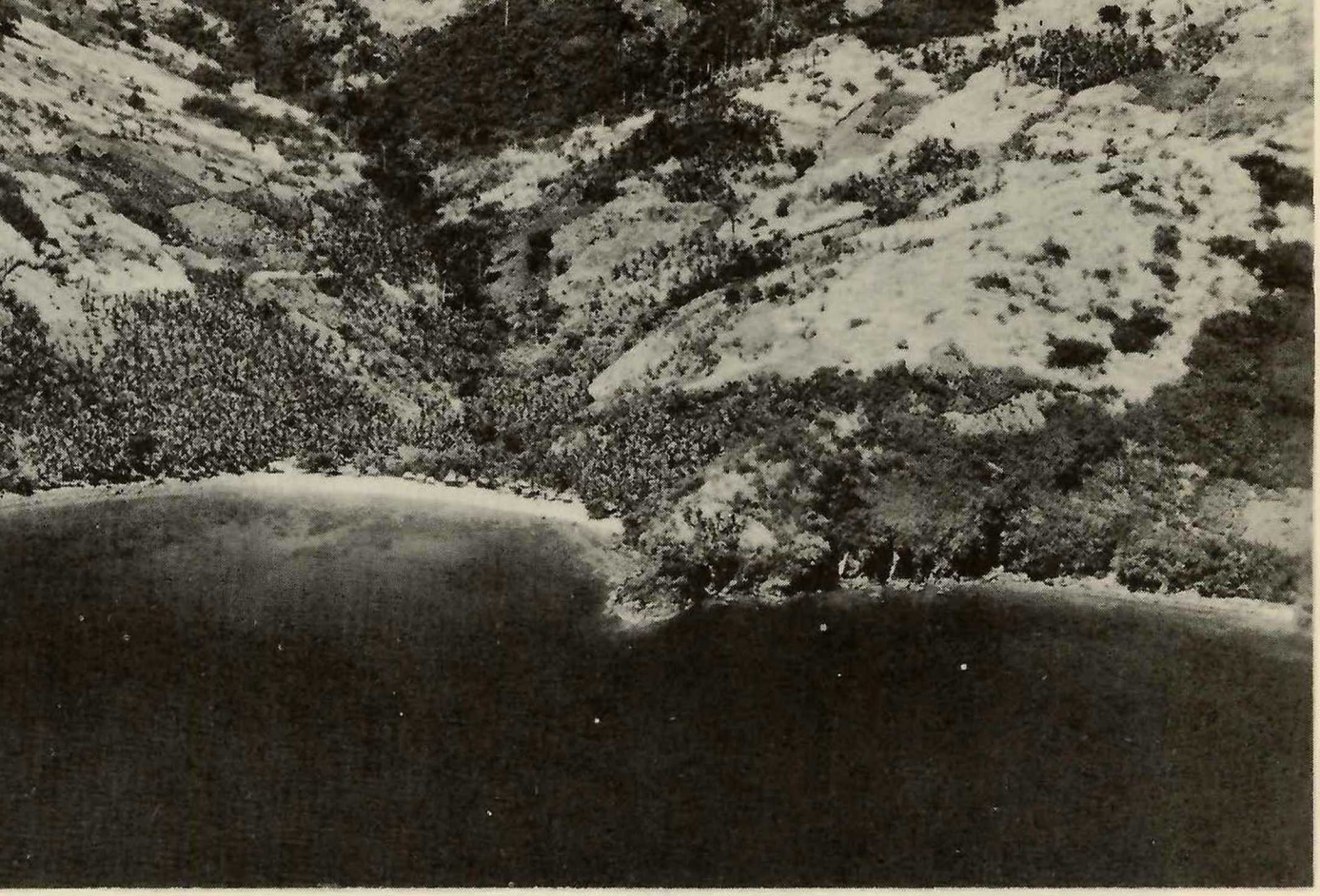


2 View of Almagro Island.
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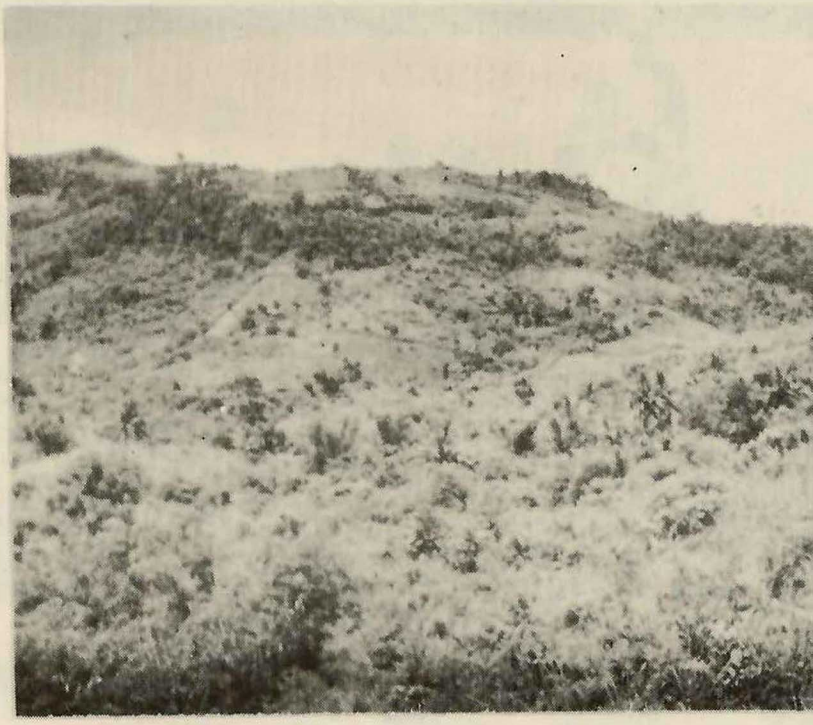




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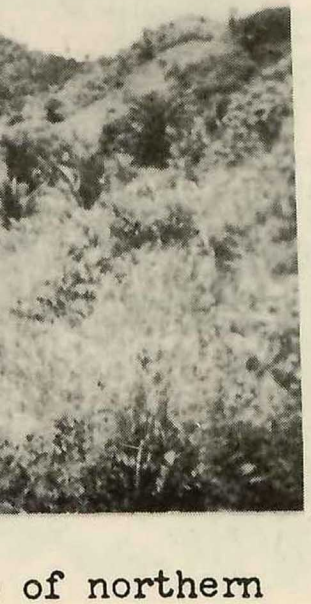


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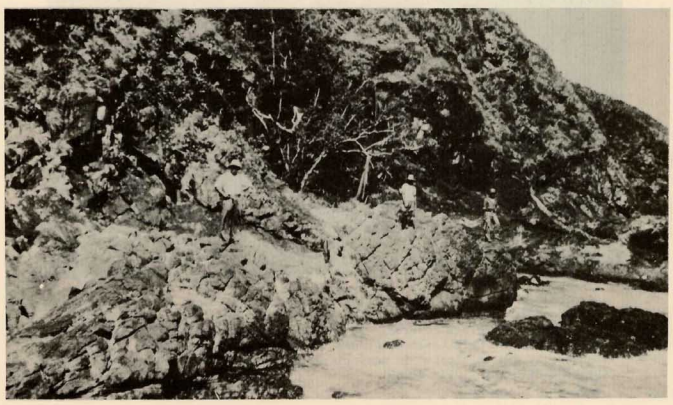
6 Low complexly dissected hills like those in foreground, with steep sides and narrow crests, are typical of much of Samar. Extensive mangrove swamps in lowland at right; back of the front ridge are found at the mouths of many of the larger rivers. (ONI 293-630)



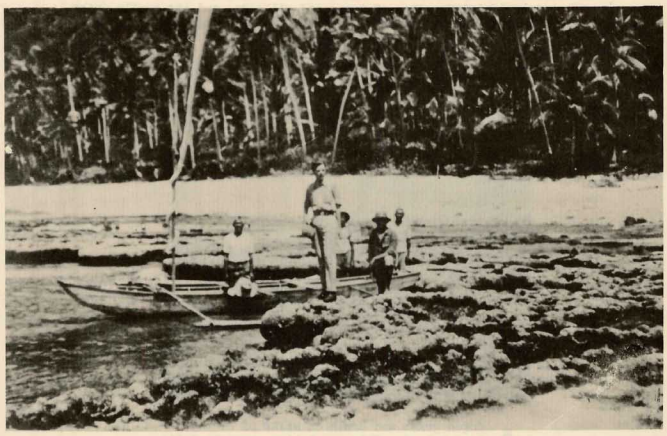
7 The numerous small coves and indentations along many parts of the coast on Samar and Leyte are typically bordered by broad sand beaches (center foreground) or by mangrove swamps as at left. Villages commonly occupy the protected flats at the bayheads. Hills largely covered by cogon grass and brush; some cultivated areas on lower slopes. Throughout Samar hills and mountains are much dissected and have steep slopes and narrow summits. (ONI 293-627)



8 Jinamoc Island in San Pedro Bay is low and gently undulating. Except for belt of trees around the coast, the island is intensively cultivated. Basey plain in the background is low; in many places swampy and poorly drained, elsewhere intensively cultivated. Mangrove swamps (north and east of the town) are barriers to landings along most of the plain. (ONI 61990)



9 Steep rocky slopes rise abruptly from the sea in many parts of the islands where no coastal plain is present. In some areas, however, a cobblestone beach lies at foot of slopes. (ONI 72862)



10 Narrow fringing coral reefs, bars at low tide, border many parts of the Samar coast. Underbrush and grass in the coconut groves (background) are common, as coconut plantations generally are not cultivated. (ONI 72861)

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SAMAR VIEWS 6-10

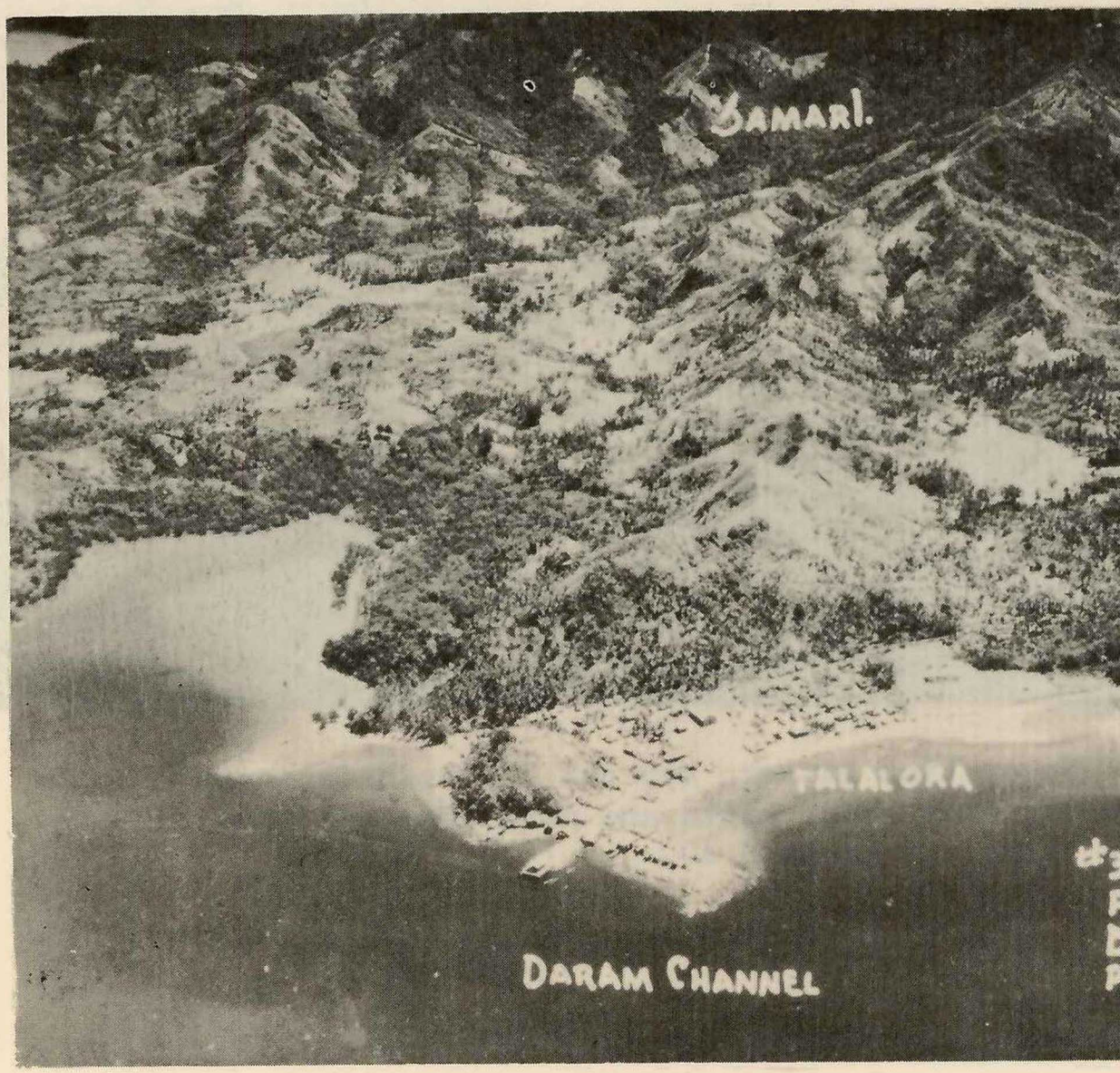


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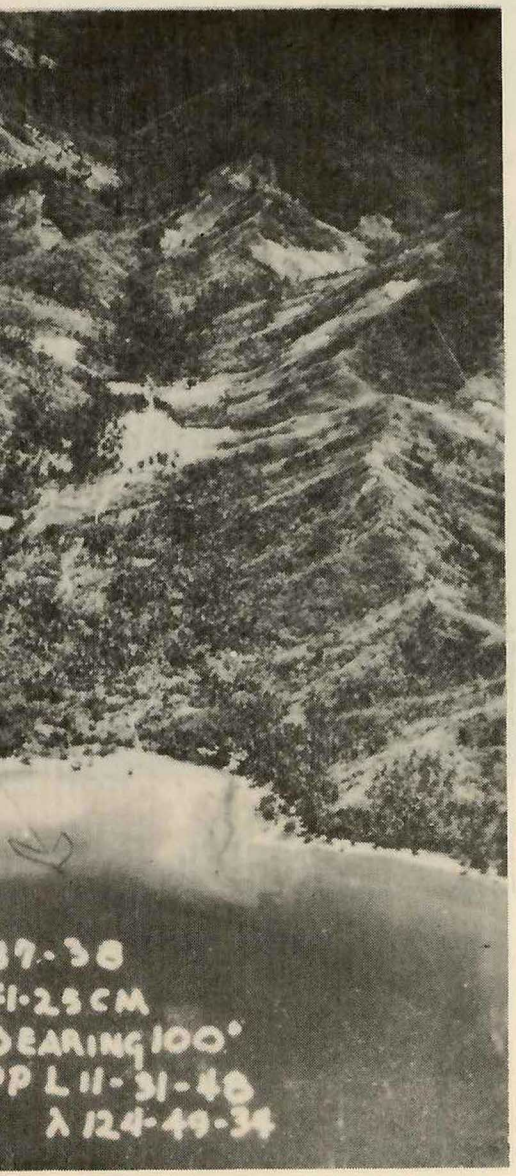


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SAMAR AND LEYTE(P.I.)



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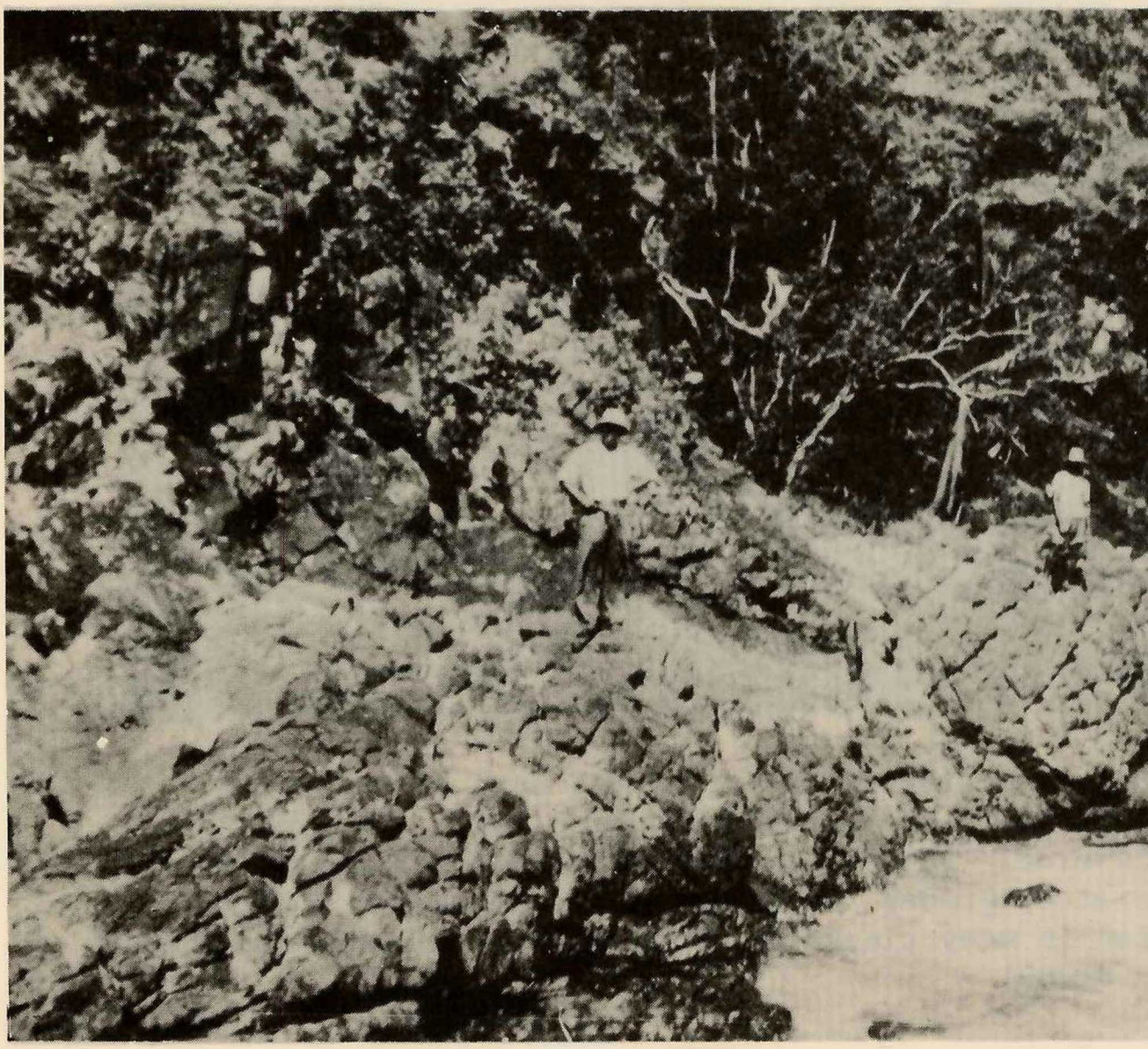
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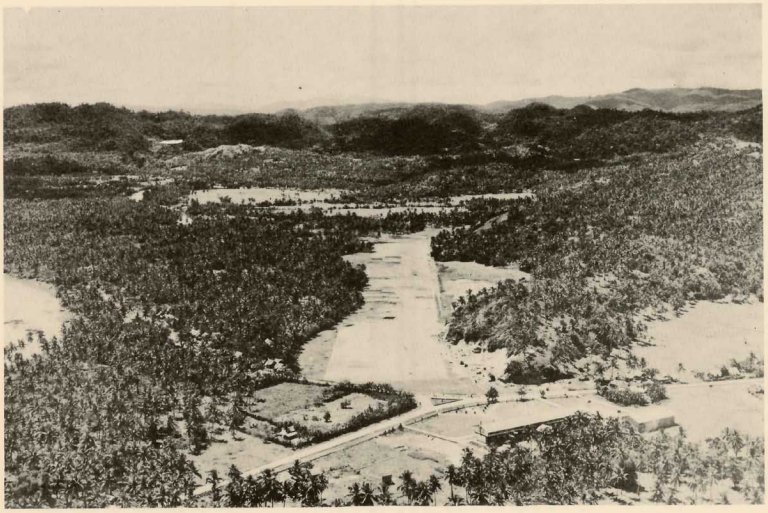


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11 Wooded slopes on southeast coast of Samar lack the dense undergrowth of tangled vines and brush which is typical of most forest areas on Samar. (OSS 94986)



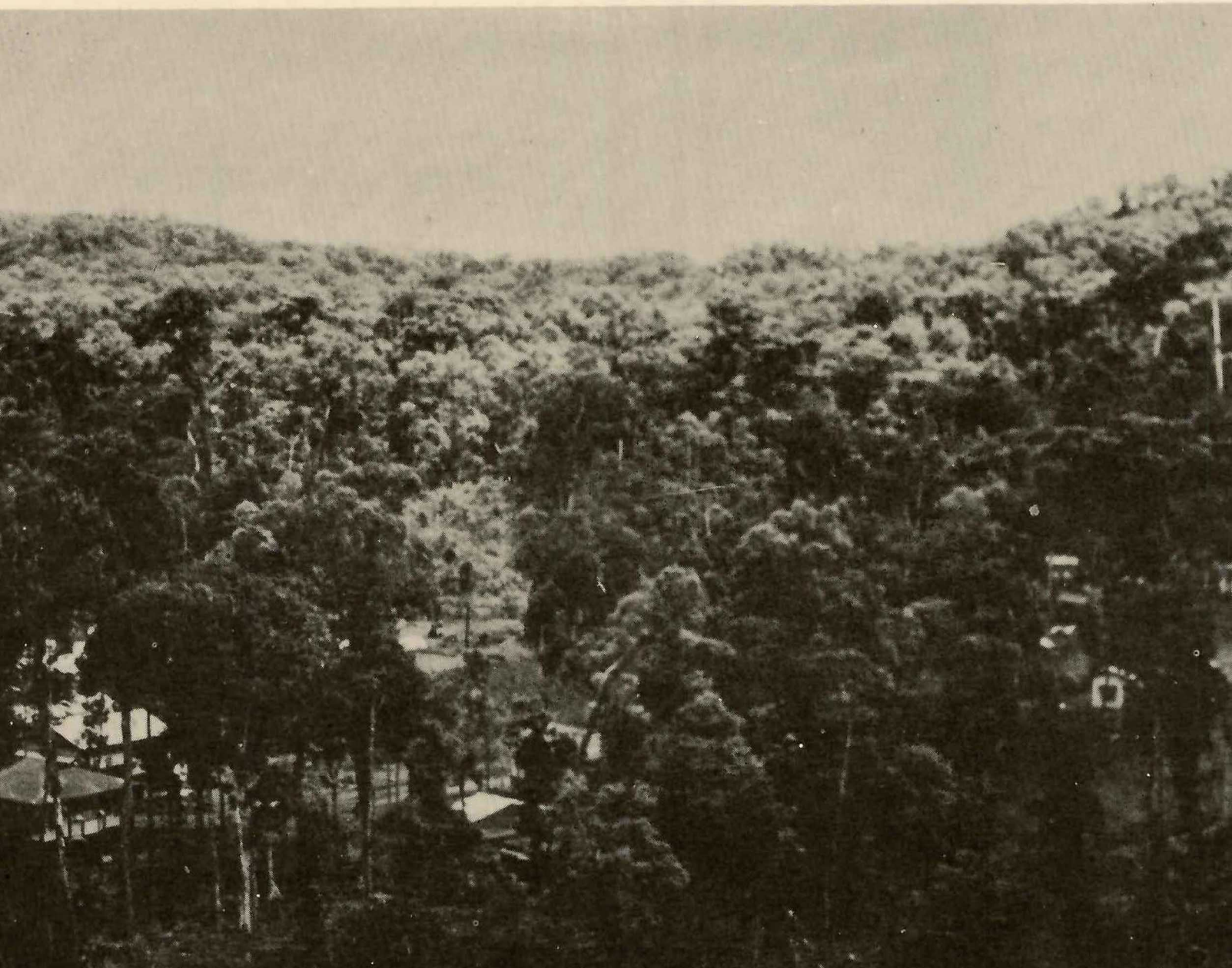
12 Large groves of coconut palms grow on most of the coastal flats and low hills where ground is sandy and fairly well-drained. Hills 100 to 300 feet high (background and right middleground) commonly lie between the narrow coastal plains and the higher mountains. Regular, smooth skyline is deceptive, as interior of Samar is rugged and mountainous although altitudes rarely exceed 2,000 feet. (1657577 AC)

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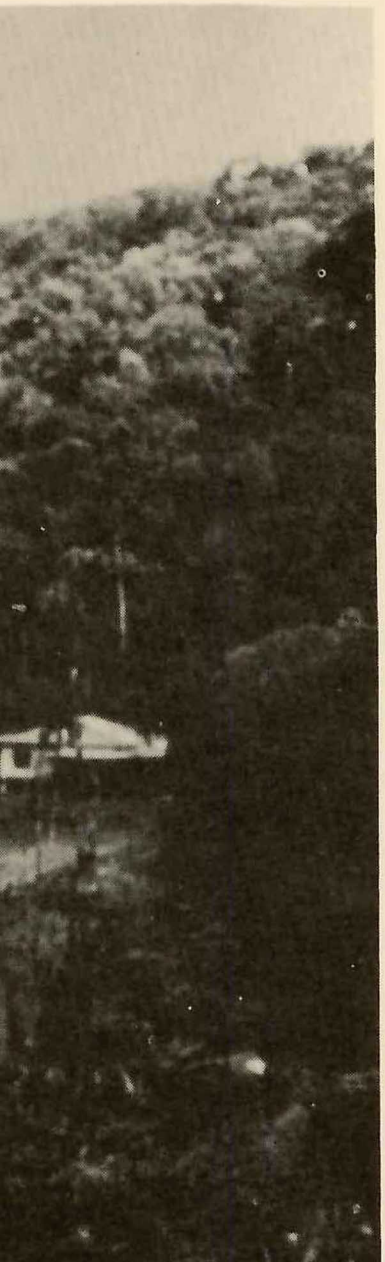
SAMAR AND LEYTE(P.I.)



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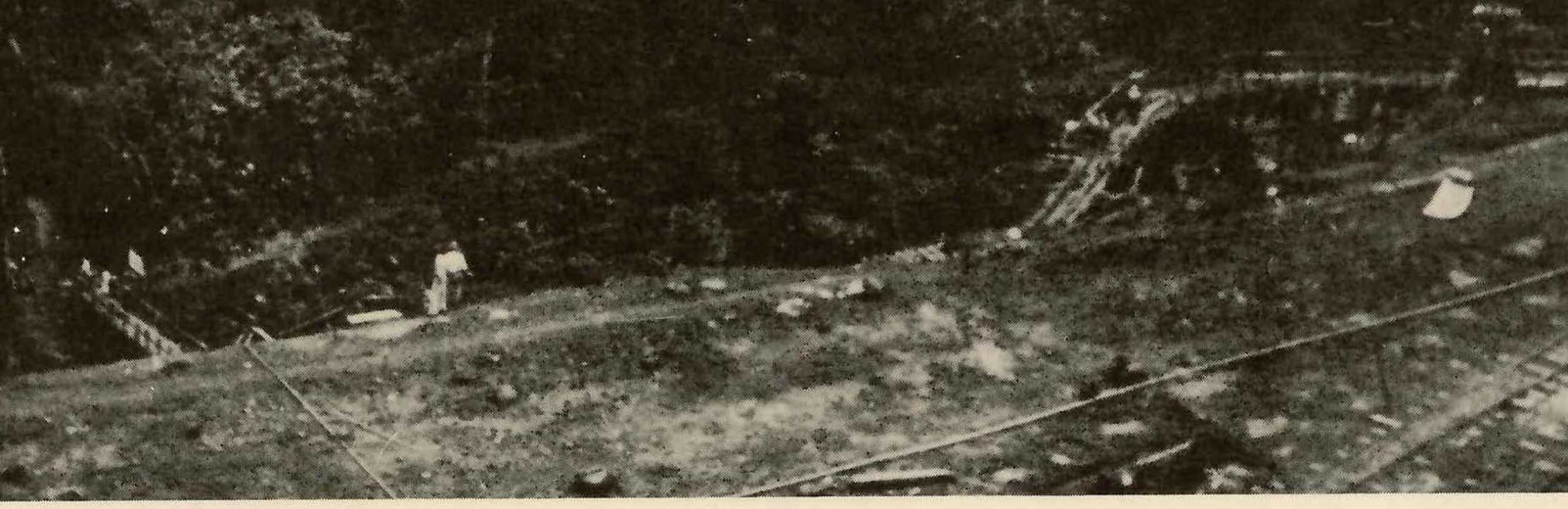


SAMAR VIEWS 11-12

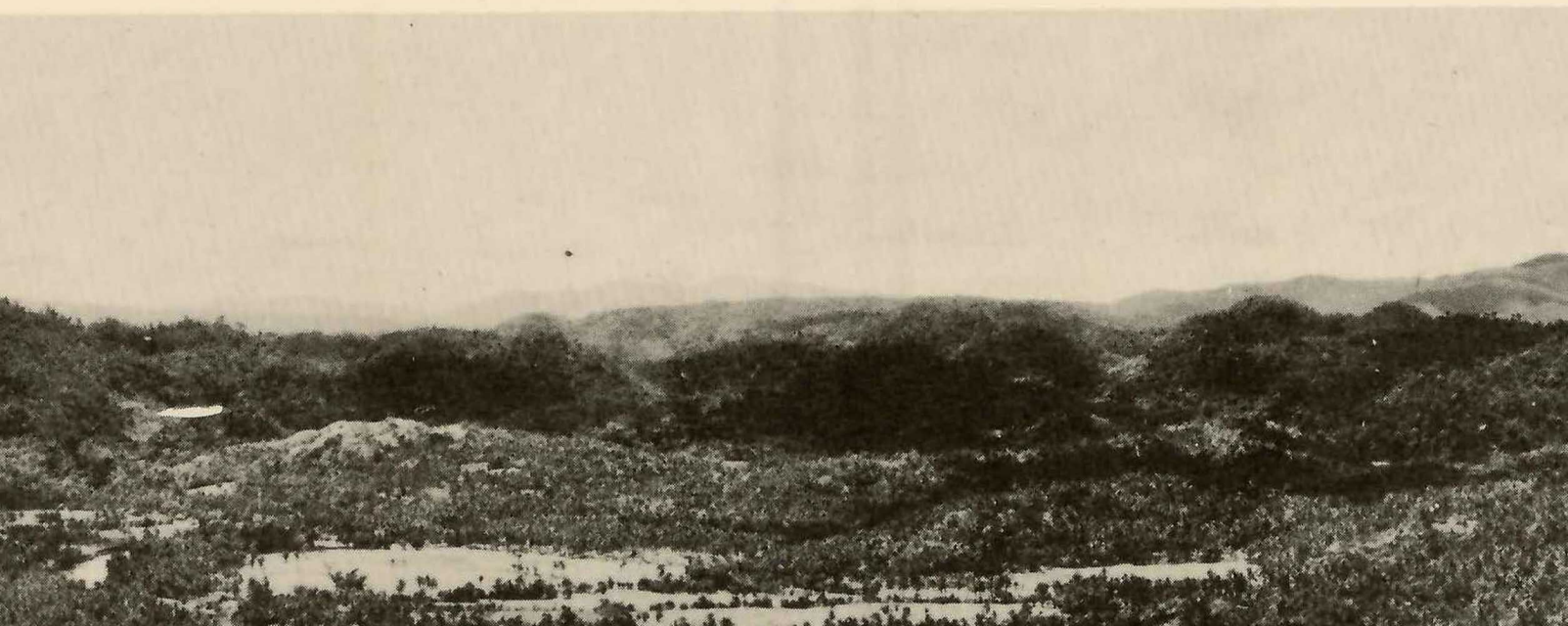






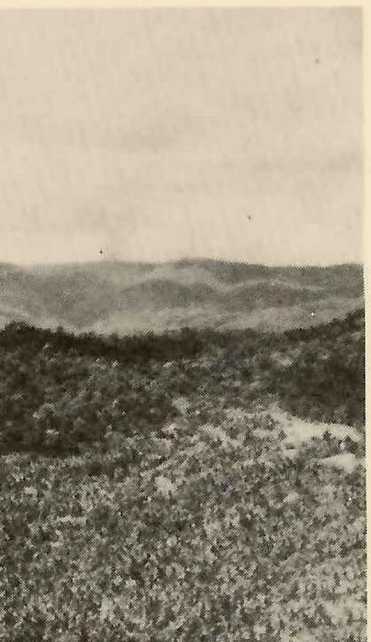


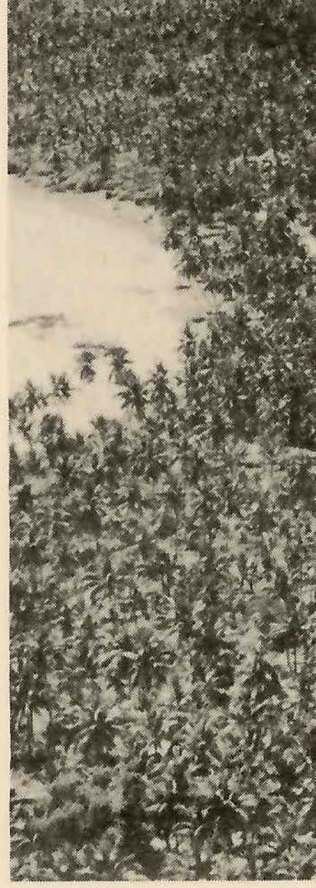
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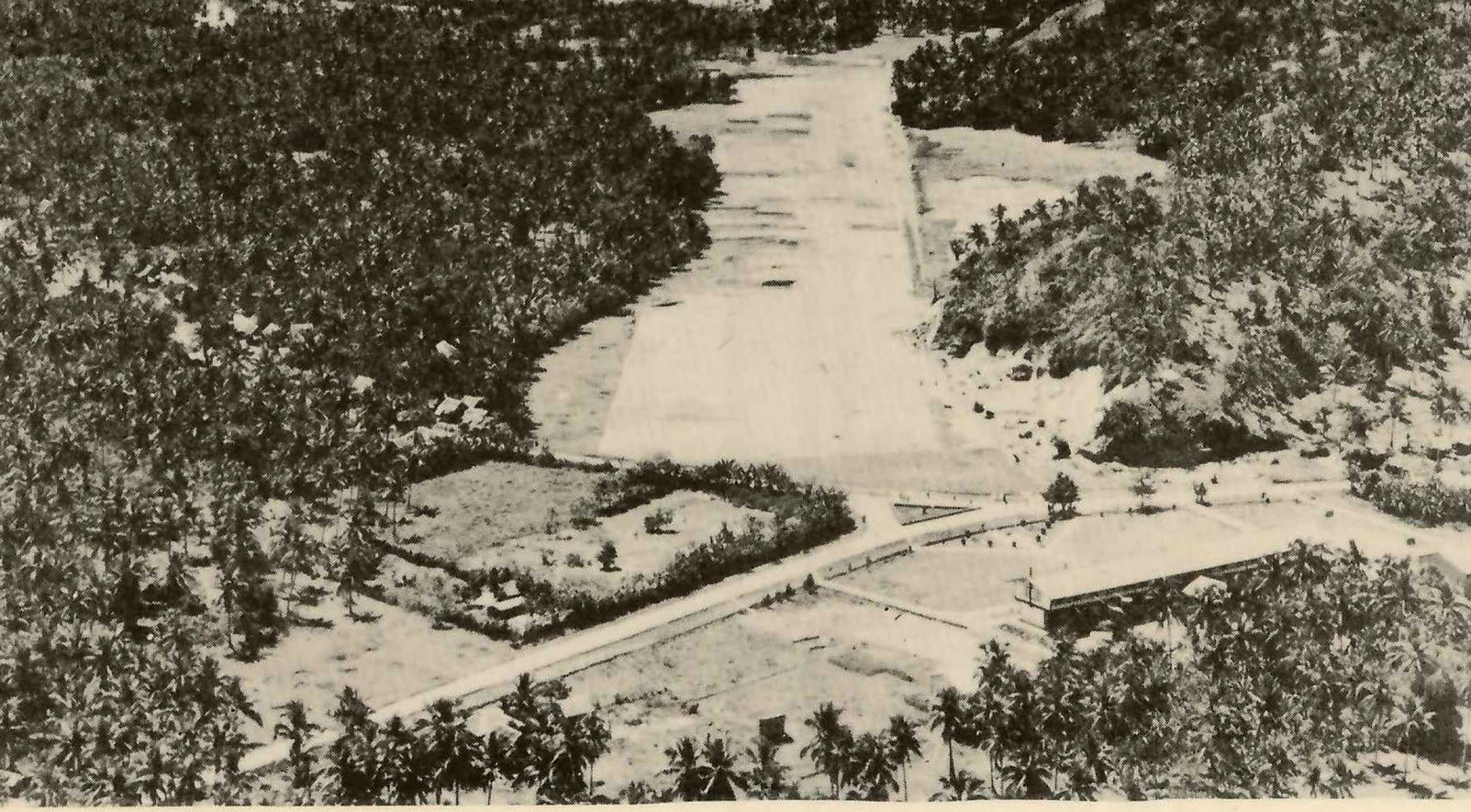




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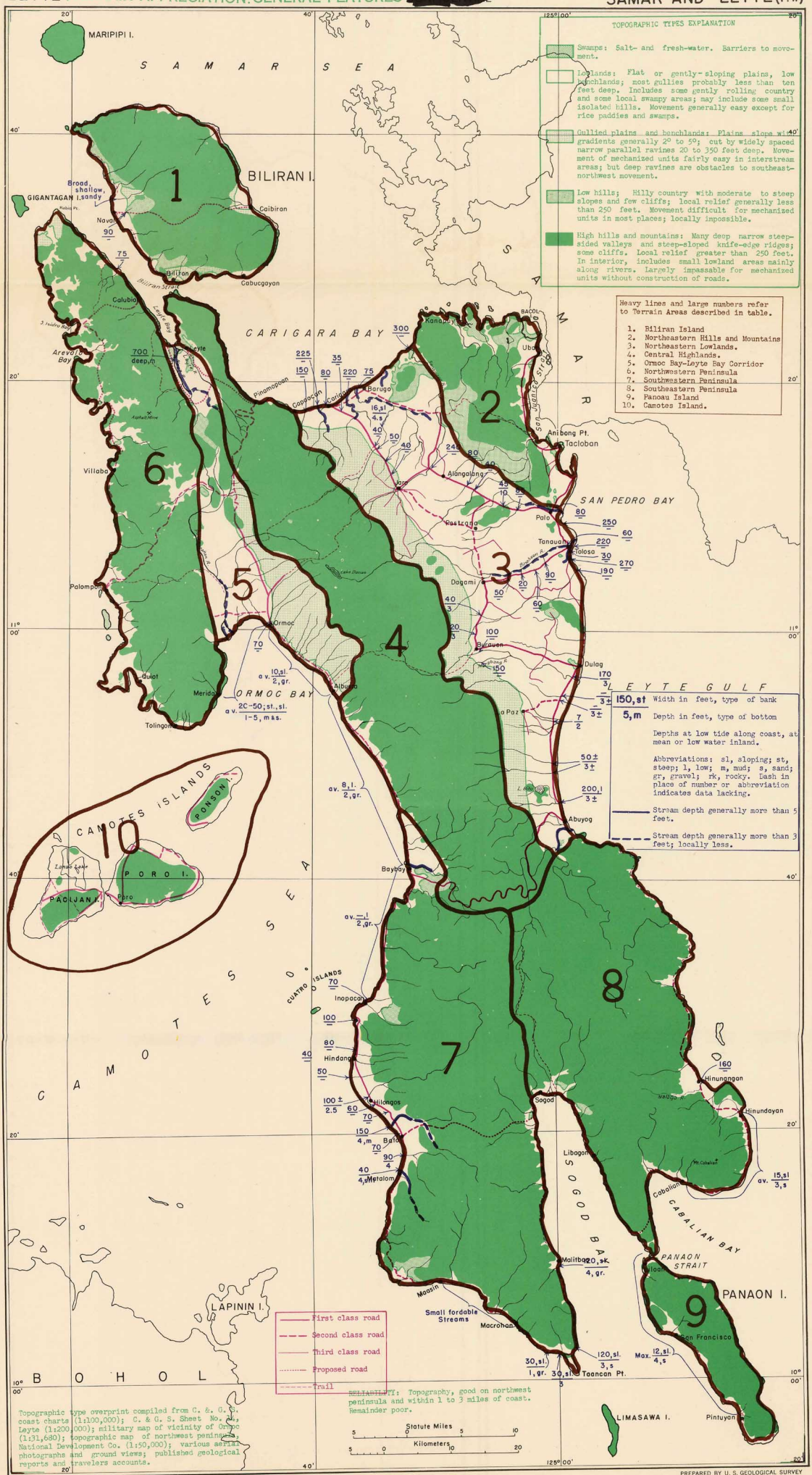


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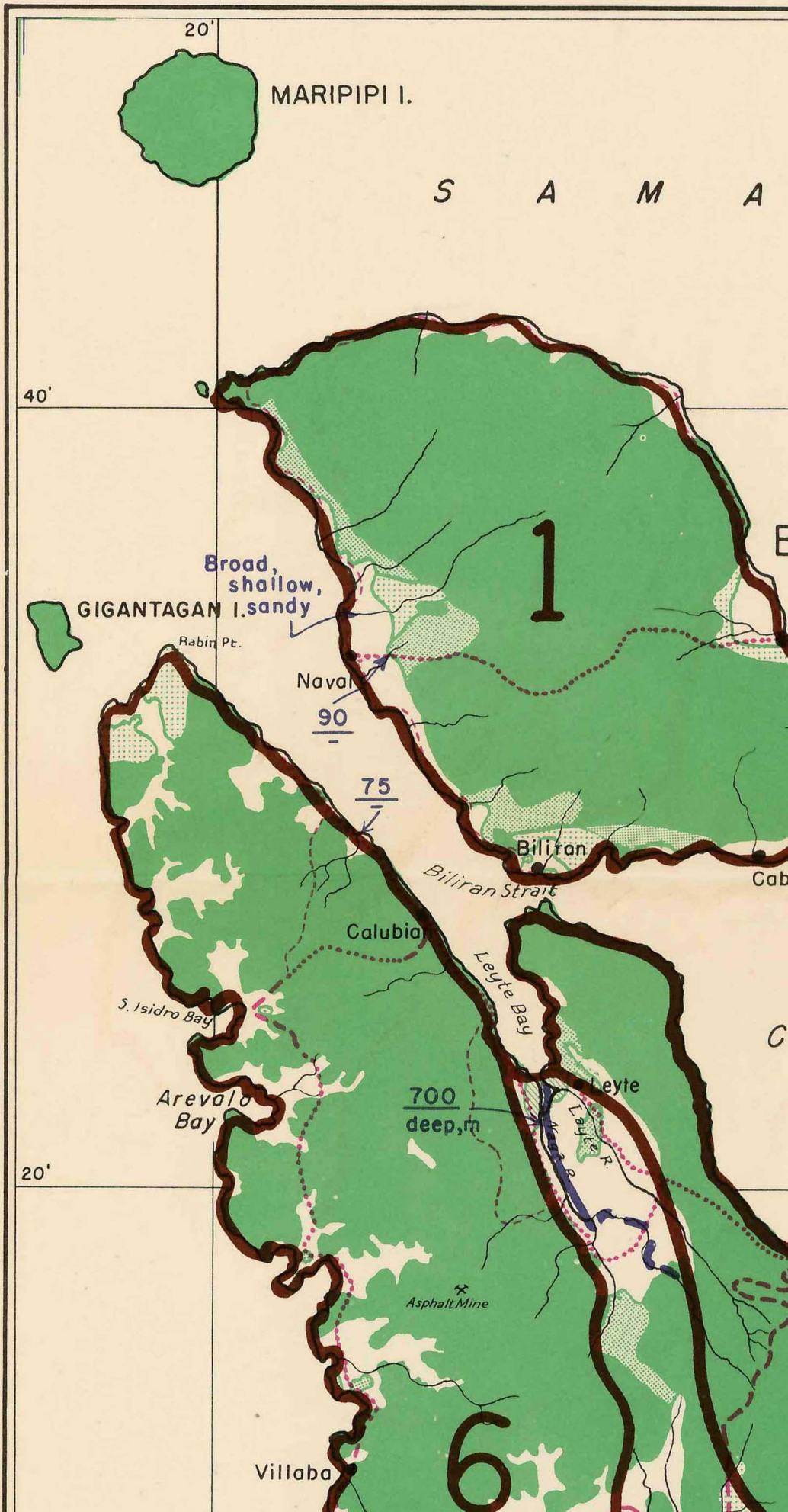
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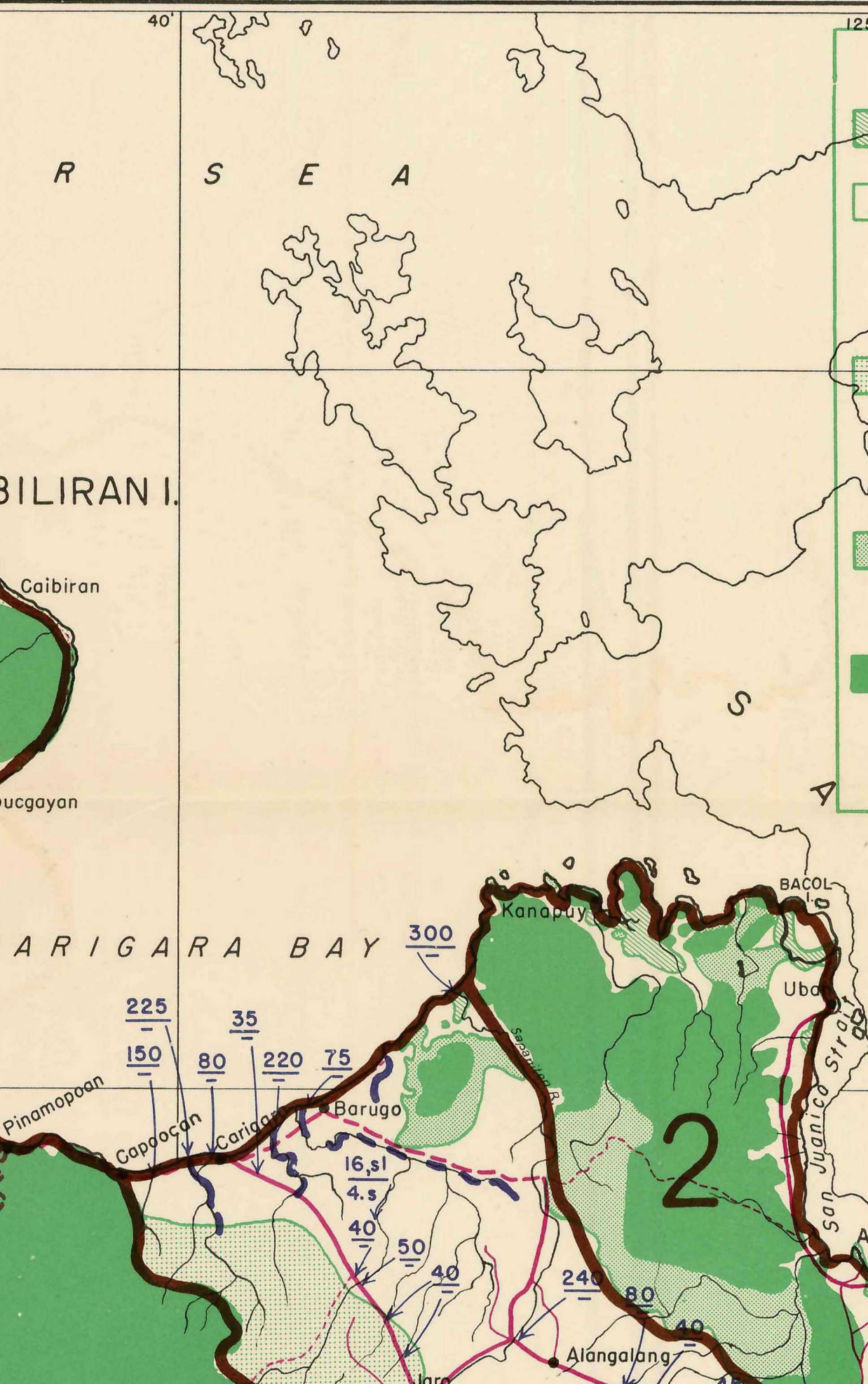
LEYTE : TERRAIN APPRECIATION: GENERAL FEATURES [redacted]

SAMAR AND LEYTE (P.I.)



LEYTE : TERRAIN APPRECIATION:




40'
R
S E A
BILIRAN I.
Caibiran
ucgayan
S
A
A R I G A R A B A Y
300
Kanapuy
BACOL I.
Uba
225
150
80
35
220
75
Pinamopoan
Capoocan
Carigara
Barugo
Sapao River
San Juanico Strait
16,s1
4.s
40
50
40
240
80
40
Alangalang
2

SAMAR AND LEYTE (P.I.)

125° 00'

20'

TOPOGRAPHIC TYPES EXPLANATION

Swamps: Salt- and fresh-water. Barriers to movement.

Lowlands: Flat or gently-sloping plains, low benchlands; most gullies probably less than ten feet deep. Includes some gently rolling country and some local swampy areas; may include some small isolated hills. Movement generally easy except for rice paddies and swamps.

40'

Gullied plains and benchlands: Plains slope with gradients generally 2° to 5°; cut by widely spaced narrow parallel ravines 20 to 350 feet deep. Movement of mechanized units fairly easy in interstream areas; but deep ravines are obstacles to southeast-northwest movement.

Low hills; Hilly country with moderate to steep slopes and few cliffs; local relief generally less than 250 feet. Movement difficult for mechanized units in most places; locally impossible.

High hills and mountains: Many deep narrow steep-sided valleys and steep-sloped knife-edge ridges; some cliffs. Local relief greater than 250 feet. In interior, includes small lowland areas mainly along rivers. Largely impassable for mechanized units without construction of roads.

Heavy lines and large numbers refer to Terrain Areas described in table.

1. Biliran Island
2. Northeastern Hills and Mountains
3. Northeastern Lowlands.
4. Central Highlands.
5. Ormoc Bay-Leyte Bay Corridor
6. Northwestern Peninsula
7. Southwestern Peninsula
8. Southeastern Peninsula
9. Panoau Island
10. Camotes Island.

20'

M

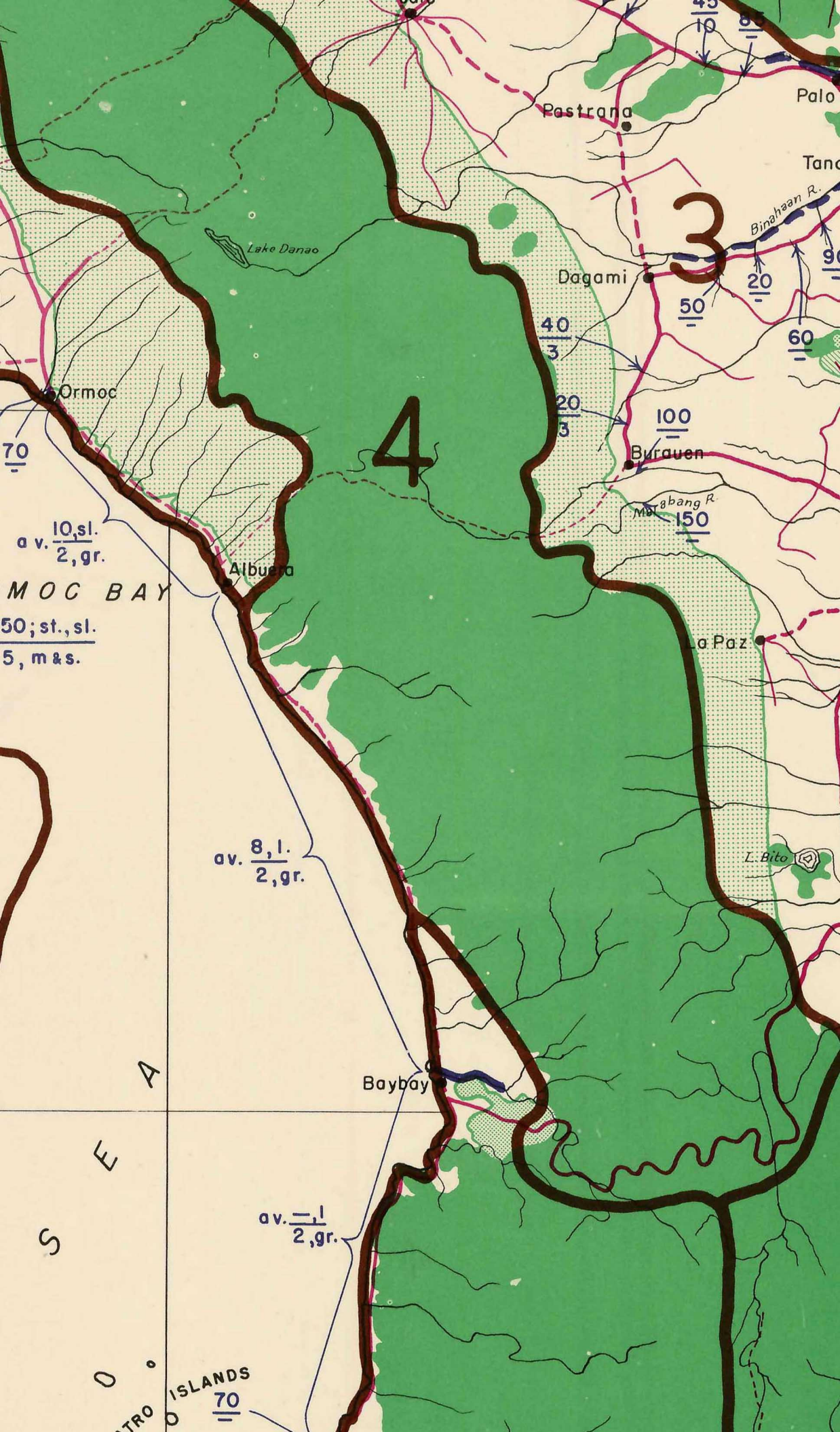
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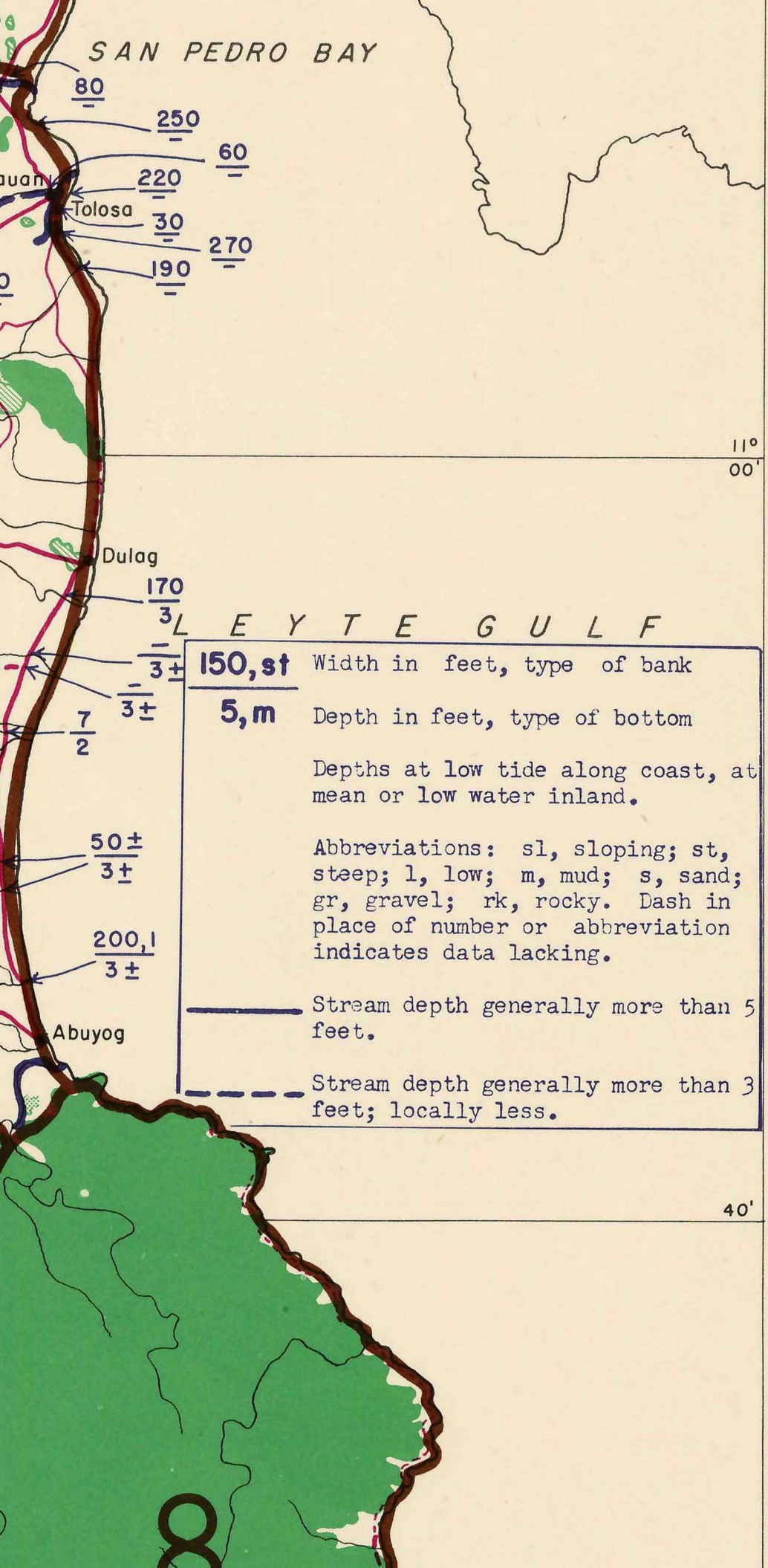
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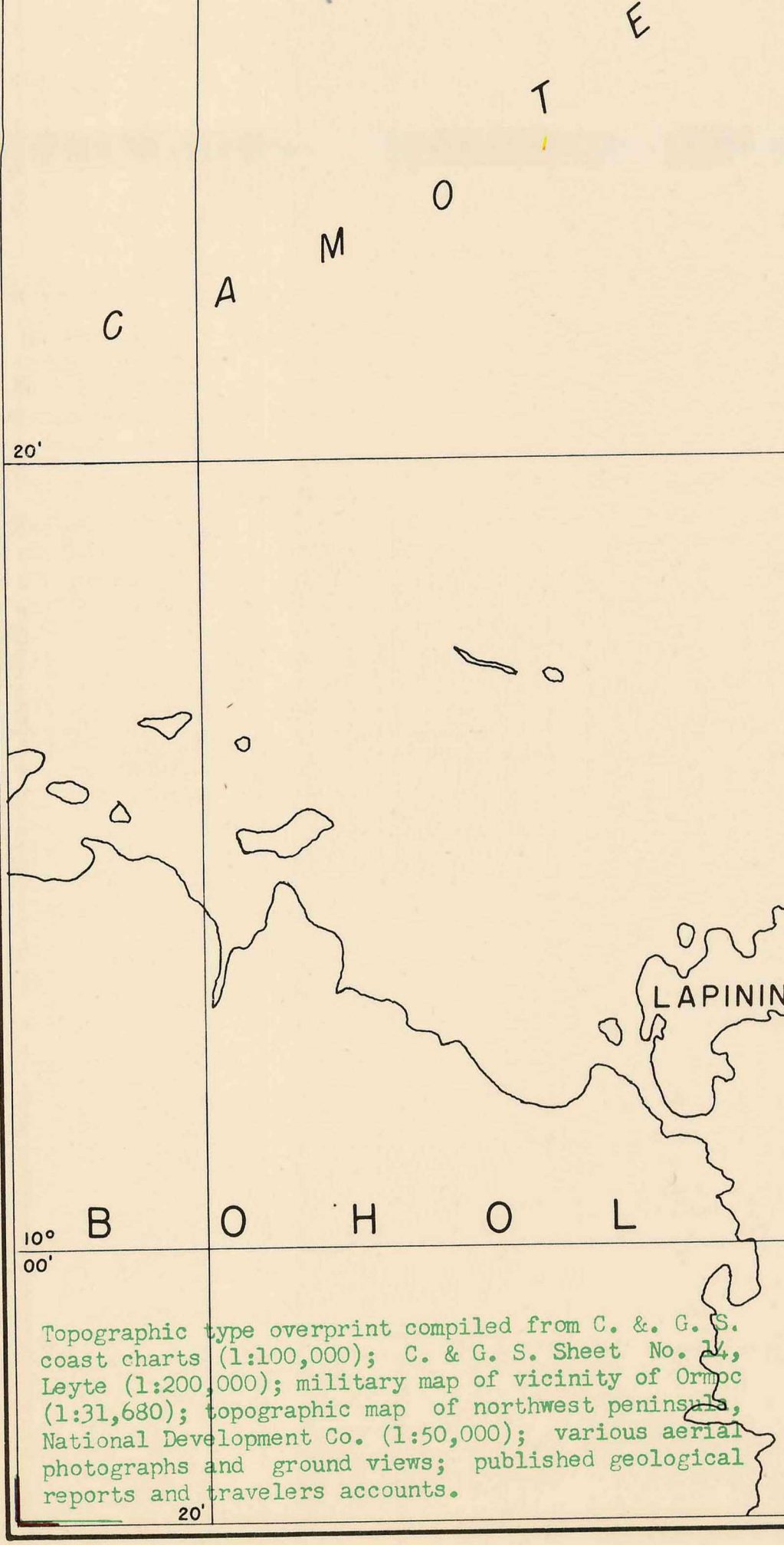
ni bong Pt.

Tacloban

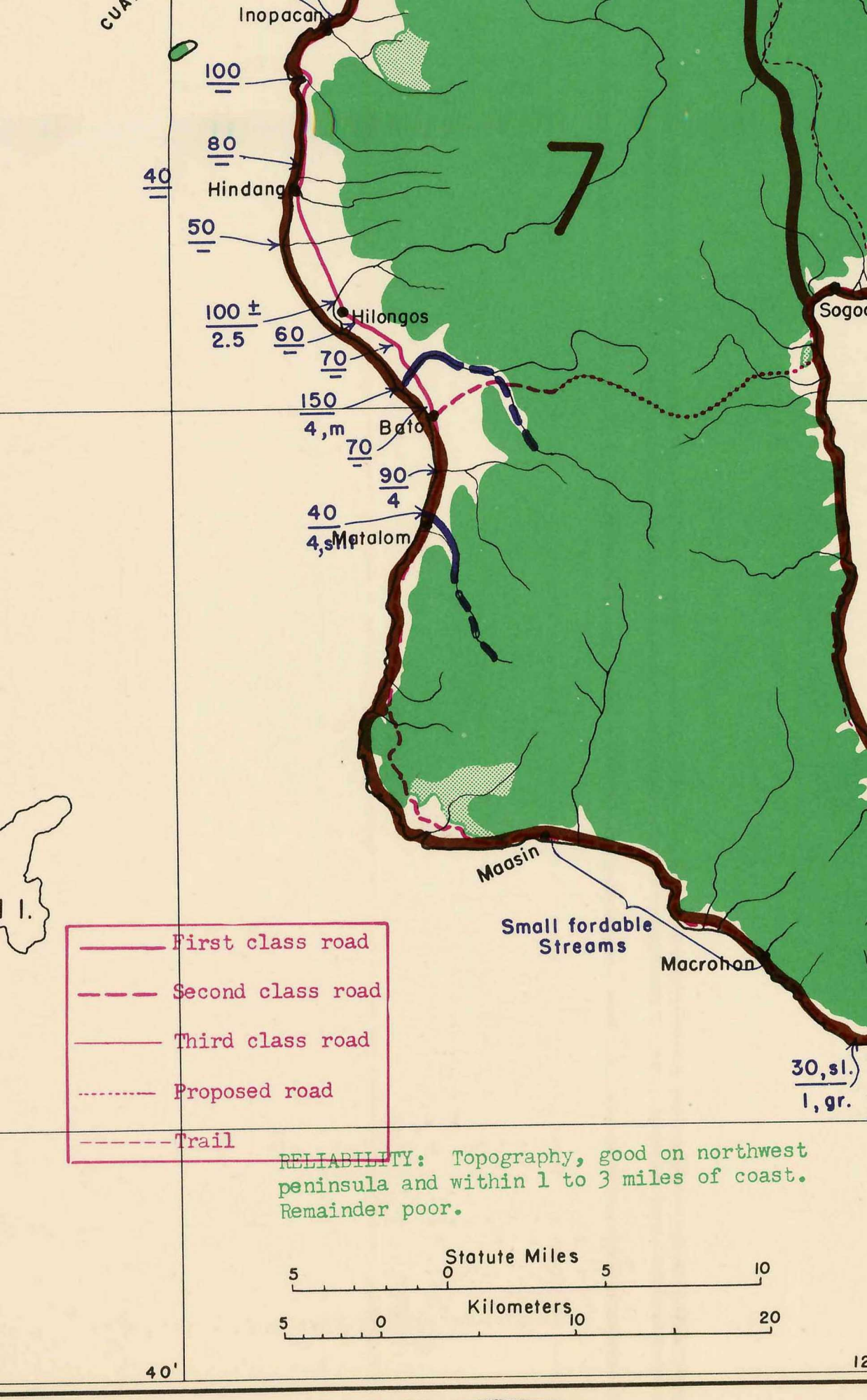

Palompon
11°
00'
Quiot
Merida
Tolingon
5
CAMOTES ISLANDS
PONSON I.
10
Lanao Lake
40'
P O R O I.
PACIJAN I.
Poro


Pastrana
Palo
Tanc
Binahaan R.
3
Lake Danao
Dagami
40
3
20
3
50
20
60
100
Burauen
4
Ormoc
70
Mahaban R.
150
La Paz
10, sl.
av. 2, gr.
Albuera
MOC BAY
50; st., sl.
5, m & s.
L. Bito
av. 8, l.
2, gr.
Baybay
SEA
av. —, l.
2, gr.
ISLANDS
70

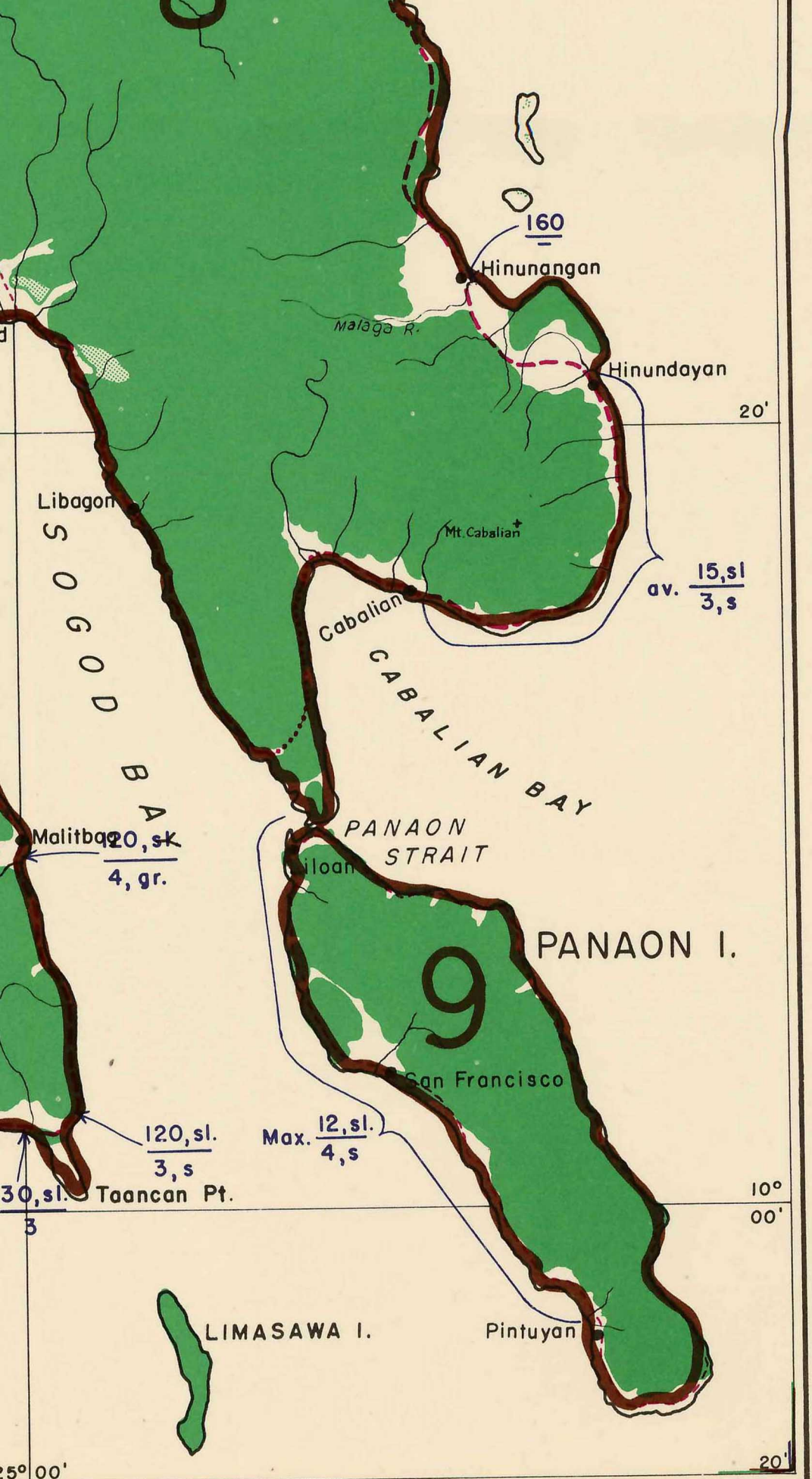

SAN PEDRO BAY
80
250
60
220
Tolosa
30
270
190
11°
00'
Dulag
170
3
LEYTE GULF
3±
3±
7
2
50±
3±
200,1
3±
Abuyog
150, st
Width in feet, type of bank
5, m
Depth in feet, type of bottom
Depths at low tide along coast, at mean or low water inland.
Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.
Stream depth generally more than 5 feet.
Stream depth generally more than 3 feet; locally less.
40'



Topographic type overprint compiled from C. &. G. S. coast charts (1:100,000); C. & G. S. Sheet No. 14, Leyte (1:200,000); military map of vicinity of Ormoc (1:31,680); topographic map of northwest peninsula, National Development Co. (1:50,000); various aerial photographs and ground views; published geological reports and travelers accounts.



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Reliability: Northwest peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte and adjacent islands, poor.

Leyte, the eighth largest of the Philippine Islands, lies near the center of the group north of Mindanao and is separated from Samar Island by the very narrow San Juanico Strait.

Leyte and the principal small islands lying close to it are generally rough and mountainous with a few broad plains. Except locally at northern end, the coast of Leyte is fairly regular although small bays and coves are numerous. Bayheads are generally sandy but many are muddy and filled with mangrove swamps. Coastal lowlands commonly are bordered by broad beaches, locally by thin lines of mangrove swamps. Elsewhere, shore is steep and commonly rocky. Leyte has only two extensive lowland areas (Areas 3 and 5). Both are characterized by a broad flat lowland from which a gently sloping plain rises to nearby mountain front. There are a few small areas of low rounded hills on the island, but most uplands are high rugged mountains. Slopes are commonly very steep and deeply dissected; some cliffs and rocky knife-edged ridges. Most valleys deep and narrow.

Except for the Camotes Group, Leyte and the small adjacent islands have a strong northwest topographic trend.

In the following table Leyte and adjacent islands have been divided into 10 terrain areas. These 10 areas comprise 6 major physiographic units.

The northeast corner of Leyte (Area 2) is largely rugged forested hills bordered on narrow San Juanico Strait by long stretches of mangrove swamp and limited areas of lowland. Except for the lowlands in the southeast corner, the area is a barrier for mechanized units.

Between the northeastern hills and the central mountains is a broad almost flat plain (Area 3) flanked on the southwest by gullied sloping plains which rise to the mountain front. These areas are intensively cultivated and are the most densely populated portion of Leyte. Most of the lowlands and sloping plains are suitable for easy deployment of large units.

High range of sharp peaks extends from the north end of Biliran Island (Area 1) throughout the entire length of Leyte (Areas 4, 7, and 8). The southern end of the range divides to form the two arms of Sogod Bay. Panaon Island (Area 9) represents the southernmost extension. The range is primarily volcanic with several high conical peaks of recently active volcanoes. There are some indications of continued volcanic activity on Biliran and in northern Leyte. The ranges form an unbroken barrier across which mechanized units cannot move without roads. Several lower less rugged areas form passes through which the roads and trails cross the mountains and probably offer the best routes even for foot troops. Narrow coastal lowland which borders some parts of the mountains permits limited use of mechanized equipment.

The broad valleys (Area 5) of the Naga and Pagsanghan Rivers, together with the low divide between them and the sloping plains on the southeast, form a corridor between the high central ranges and the rugged northwestern peninsula. Although there are serious local obstacles, most of the corridor is negotiable by mechanized equipment.

The northwest peninsula (Area 6) has rough broken terrain. From the low rolling cultivated land at the north end, the ground rises to high rugged timbered hills. Most of the northern tip of the peninsula can be used by mechanized units, but the remainder of the area is generally impassable without construction of roads.

The Camotes Islands (Area 10) off the western coast of Leyte are a distinct topographic group from Leyte, Biliran, and Panaon. These islands have a central hilly core bordered by flat coral lowlands which terminate in low bluffs. Troops and mechanized units can probably move through all except the rough high parts, but the bluffs around nearly all the coasts make access difficult.

Area Number and Name	Topography[a/][b/]	Movement[c/][d/]	Observation and Concealment[a/]	Cover
1 BILIRAN ISLAND	General: Rugged mountainous island with steep volcanic peaks rising abruptly from the beaches or behind restricted irregular coastal lowlands. Uplands are unbroken by any corridor which might permit ready access from coast to coast. The principal lowland areas are largely under cultivation; central parts usually covered by rice paddies. The surrounding higher mountains and lower mountain slopes are cultivated to corn or hemp, or overgrown by cogon grass. Mountainous interior is heavily forested. Coastal Features: Shore line on east and north coast of island is fairly regular; nearly all coral-sand beach; interrupted in a few places by rocky bluffs, heaps of cobblestones, or mangrove swamps. West and south coasts are somewhat more irregular. Coast is broken by several small mangrove-lined bays which alternate with shingle beaches. A few prominent rocky points stand out on northwest tip and along Biliran Strait. Lowlands: Except for the plains around the towns of Caibiran, Biliran, and Naval, lowlands are confined to narrow discontinuous strips of coastal plain or, locally, to low terraces and hills along the shore. Lowlands are interrupted by steep spurs and rough mountain slopes which descend directly to the beach and terminate in rocky headlands. The Caibiran Plain on east-central coast and the slightly larger Naval Plain on the west coast have similar topography. The seaward and central parts are low, nearly flat, and in general are poorly drained. The inland parts rise in broad gently sloping fans to the surrounding mountains. Slopes are generally less than 3% and are dissected by narrow forested ravines 10 to 50 feet deep. The Biliran Lowland on the south coast has three divisions. The smaller central part of low wet ground around the town itself is not more than a square mile or two in area. Gently sloping benchland about 100 feet high partly encircles the low rice land. East of the benchland irregular hills and shallow open valleys form a coastal belt which gradually merges with the surrounding higher and more rugged mountains. Mountains: The highest mountains form a belt across the eastern side of the island. Altitudes generally range from 2,500 to more than 4,000 feet. Maximum altitude of 4,264 is attained by Mt Suiro, the highest of a cluster of jagged peaks forming the southeast corner of the island. The second highest, Mt Naliwatan, at the northeast end has an altitude of more than 4,230. From these points altitudes gradually decrease to less than 1,500 feet on passes located northwest of Caibiran. A second lower group of mountains forms the western side of the island. Altitudes are generally between 1,000 and 2,000 feet. Near the west coast many parts of hill lands are less than 1,000 feet. In the southern part around Biliran Strait, uplands are commonly 400 to 600 feet above sea level. In general, lower slopes are fairly regular; cut at wide intervals by shallow ravines full of brush or trees. On most of the island, slopes below 500 feet altitude are generally less than 10%; below 1,000 feet less than 20%. Most of these slopes are under cultivation. At north and northwest end, slopes above 400 feet are too steep to cultivate. Above the cultivated zone slopes become very steep.	General: Barrier area. Most of island impassable for mechanized units without construction of roads. Low plains around main towns only areas suitable for mechanized equipment. Beaches bordering plains suitable for landings. Central part of lowlands has muddy clay soil which gives poor footing; more sandy soil on higher somewhat better-drained parts of lowland provides fairly good footing. Stony clay soil of mountains is slippery and sticky when wet. Existing Roads and Trails: No roads except for short stretches through towns. Trail follows coast around most of island; probably usable for motorized equipment with some improvement. Good trail from Naval to Caibiran crosses lowest part of mountains. Cross-Country Movement: Most of island impassable for mechanized units and difficult even for foot troops. Naval-Caibiran trail follows easiest cross-island route. Troops can skirt the mountainous interior by moving through low hills and narrow lowlands on coast. Topography of plains around Naval, Biliran, and Caibiran suitable for mechanized units; however, easy movement hampered by extensive areas of rice paddies in central parts of plains. Steep-sided ravines are most serious obstacles on higher sloping plains around the rice lands. Rivers: Streams crossing Naval and Caibiran plains probably cannot be forded in their lower reaches at high tide. Other streams can be forded at several points except during and after heavy rains.	Observation: High rugged forested mountains make ground and aerial observation poor in most parts of island. Cloud cover is serious problem. Some observation points can be found on cleared mountain slopes which command most of the lowlands on Biliran and part of the Leyte Mainland. Concealment: Dense vegetation and rough terrain provide good concealment in most parts of island. On lowland, concealment is lacking for large units. Scattered trees and low brush provide some concealment for personnel.	Natural Cover: Broken, rugged terrain gives good cover for troops on most of the island. Earth embankments in paddy areas, and ravines and stream banks are principal sources of cover for personnel. No cover for large mechanized units. Artificial Cover: Fox holes easily excavated in lowlands, but in many places excavations fill with water. Margins of plains better drained and may have suitable sites for cut-and-cover shelters. In mountains, soil probably commonly deep enough to permit excavations for fox holes and, locally, for cave shelters. Upper slopes too rocky and soil too thin.
2 NORTHEASTERN HILLS AND MOUNTAINS	General: Northeastern corner of Leyte is occupied largely by irregular group of steep-sided hills. Except in the northwest corner, the seaward side of the uplands is bordered by low irregular plains and mangrove swamps. Coastal lowlands and hills behind the mangrove swamps are covered by grass or woods. Cultivated plains to west and southwest of Tacloban. Coconut palms cover much of lowlands south of Tacloban. Interior is mostly forest covered. Coastal Features and Lowlands: The stretch of shore west of Kanapuy is mostly rocky with sand beaches at small bayheads. Except for small patches of lowlands, steep slopes border the shore and in places form prominent rocky headlands. From Kanapuy nearly to Tacloban most of shore is bordered by mangrove swamp. Between Bacol Island and Kanapuy, low hills, with small areas of flat ground, commonly lie behind the swamps, or descend directly to the sea. South of Bacol Island, the ground inland from the mangroves is in part poorly drained flats; in part, very low hills. From Anibong Point southward the shore has a sand beach backed by broad coastal flats interrupted by line of low hills west of Tacloban; flats are in large part covered by coconut palms; some parts very poorly drained and swampy. Hills and Mountains: Except for the coastal lowlands and swamps, the entire area is rough mountains and hills. Marginal hills range from 150 to more than 600 feet in altitude. The higher uplands are between 1,400 and 2,300 feet. Nearly all the hills and mountains have very sharp narrow summits. Slopes are very steep, mostly more than 25%. Generally slopes meet the surrounding lowlands at very sharp angles. Only locally on the southwest side of the mountains do small alluvial fans form a transition zone of moderate to gentle slope between the plains and the steep hills. The valleys are commonly steep-walled and very narrow. To the south, a few of the larger valleys become wider and more open with some well-developed valley flats. Central part of the uplands is densely wooded. Remainder has large areas of brush and cogon grass with small areas of cultivated ground and some trees. Rivers: Largest rivers flow through the northern part of the area. During the dry season most are probably less than 4 feet deep and less than 150 feet wide except near their mouths. River mouths commonly are fringed by dense mangrove forests. In the remainder of the area streams are short and fairly small. Gradients moderate to steep except where they cross the narrow lowlands. Streams subject to sudden rises in level during long heavy rains.	General: Movement of mechanized units largely restricted to coastal lowlands on east coast; remainder of area unsuitable without construction of roads. Most of area has slippery clay soil which provides poor footing. Sandy ground around Tacloban gives fairly good footing, although some parts are poorly drained and swampy. Existing Roads and Trails: Good surfaced road from Palo (in Area 3) north to the Samar ferry-crossing (23 miles north of Tacloban) near Bacol Island; single lane road; only one that probably is suitable for all-weather use by heavy traffic. A few poor, little-used trails into the mountains. Cross-Country Movement: Movement of mechanized units is easy on nearly all parts of plain around and south of Tacloban. North of Tacloban, easy movement greatly restricted by mangrove swamps and poorly drained ground inland from the swamps. A few valleys near south end of mountains may permit use of tanks. In remainder of area, movement is difficult even for foot troops. Steep slopes and heavy vegetation are serious obstacles through mountains. Extensive mangrove swamps make limited areas of low ground on north coast almost impassable. Rivers: Larger rivers on north coast can be used by small boats for mile or two from mouths; lower reaches of these rivers probably not fordable. None of small streams on east coast are navigable. Nearly all can be forded during drier weather; most difficult to ford during rainy weather; some impassable. Except at mouths gravel and rock channels give good footing.	Observation: Excellent views of lowland south of Tacloban can be obtained from uplands to west and from low hills near the town. Aerial observation excellent. In remainder of area dense vegetation and rough terrain make observation poor. Concealment: Open brush and grasslands along parts of coast north of Tacloban, and coconut palms and grass to south provide limited cover for personnel. Wooded hills in remainder of area afford good concealment for fairly large troop units.	Natural Cover: Almost no cover on plains around Tacloban except for low hills west of town. Elsewhere in area, numerous ravines, valleys, mountain spurs provide good cover. Artificial Cover: Lowlands largely unsuitable; excavations fill with water. Soil and decayed rock on hillsides generally deep enough to permit excavations of fox holes; excavations probably subject to slumping. Cave shelters can be excavated in most parts of hills; timber for supports abundant.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

(continued)

LEYTE (P.I.) TERRAIN APPREC

Reliability: North

Leyte, the eighth largest of the Philippine Island lies near the center of the group north of Mindanao and separated from Samar Island by the very narrow San Jua Strait.

Leyte and the principal small islands lying close it are generally rough and mountainous with a few broad plains. Except locally at northern end, the coast of Le is fairly regular although small bays and coves are num ous. Bayheads are generally sandy but many are muddy a filled with mangrove swamps. Coastal lowlands commonly bordered by broad beaches, locally by thin lines of man grove swamps. Elsewhere, shore is steep and commonly Leyte has only two extensive lowland areas (Areas 3 and Both are characterized by a broad flat lowland from whi gently sloping plain rises to nearby mountain front. are a few small areas of low rounded hills on the islan but most uplands are high rugged mountains. Slopes are commonly very steep and deeply dissected; some cliffs a rocky knife-edged ridges. Most valleys deep and narrow

Except for the Camotes Group, Leyte and the small jacent islands have a strong northwest topographic tren

In the following table Leyte and adjacent islands been divided into 10 terrain areas. These 10 areas com prise 6 major physiographic units.

Area Number and Name	Topograph
1	General: Rugged mountainous island w abruptly from the beaches or behind

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IATION GENERAL FEATURES

west peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte

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The northeast corner of Leyte (Area 2) is largely rugged forested hills bordered on narrow San Juanico Strait by long stretches of mangrove swamp and limited areas of lowland. Except for the lowlands in the southeast corner, the area is a barrier for mechanized units.

Between the northeastern hills and the central mountains is a broad almost flat plain (Area 3) flanked on the southwest by gullied sloping plains which rise to the mountain front. These areas are intensively cultivated and are the most densely populated portion of Leyte. Most of the lowlands and sloping plains are suitable for easy deployment of large units.

High range of sharp peaks extends from the north end of Biliran Island (Area 1) throughout the entire length of Leyte (Areas 4, 7, and 8). The southern end of the range divides to form the two arms of Sogod Bay. Panaon Island (Area 9) represents the southernmost extension. The range is primarily volcanic with several high conical peaks of recently active volcanoes. There are some indications of continued volcanic activity on Biliran and in northern Leyte. The ranges form an unbroken barrier across which mechanized units cannot move without roads. Several lower less rugged areas form passes through which the roads and trails cross the mountains and probably offer the best routes even for foot troops. Narrow coastal lowland which borders some parts of the mountains permits limited use of mechanized equipment.

ny[a/][b/]	Movement[c/][d/]
with steep volcanic peaks rising restricted irregular coastal low-	General: Barrier area. Most of isl impassable for mechanized units with

SAMAR AND LEYTE(P.I.)

and adjacent islands, poor.

The broad valleys (Area 5) of the Naga and Pagsanga-han Rivers, together with the low divide between them and the sloping plains on the southeast, form a corridor between the high central ranges and the rugged northwestern peninsula. Although there are serious local obstacles, most of the corridor is negotiable by mechanized equipment.

The northwest peninsula (Area 6) has rough broken terrain. From the low rolling cultivated land at the north end, the ground rises to high rugged timbered hills. Most of the northern tip of the peninsula can be used by mechanized units, but the remainder of the area is generally impassable without construction of roads.

The Camotes Islands (Area 10) off the western coast of Leyte are a distinct topographic group from Leyte, Biliran, and Panaon. These islands have a central hilly core bordered by flat coral lowlands which terminate in low bluffs. Troops and mechanized units can probably move through all except the rough high parts, but the bluffs around nearly all the coasts make access difficult.

	Observation and Concealment[a]	Cover
and out	Observation: High rugged forested mountains make ground	Natural Cover: Broken, rugged terrain gives good cover

BILIRAN ISLAND	lands. Uplands are unbroken by any c access from coast to coast. The prin under cultivation; central parts usu The surrounding higher mountains and vated to corn or hemp, or overgrown by terior is heavily forested. Coastal Features: Shore line on east ly regular; nearly all coral-sand bea rocky bluffs, heaps of cobblestones, south coasts are somewhat more irregu small mangrove-lined bays which alter prominent rocky points stand out on n Strait. Lowlands: Except for the plains a rou and Naval, lowlands are confined to n coastal plain or, locally, to low ter Lowlands are interrupted by steep spu descend directly to the beach and ter Caibiran Plain on east-central coast Plain on the west coast have similar central parts are low, nearly flat, a The inland parts rise in broad gently mountains. Slopes are generally less narrow forested ravines 10 to 50 feet south coast has three divisions. The ground around the town itself is not area. Gently sloping benchland abou the low rice land. East of th shallow open valleys form a coastal b surrounding higher and more rugged mo Mountains: The highest mountains for of the island. Altitudes generally n feet. Maximum altitude of 4,264 is a of a cluster of jagged peaks forming The second highest, Mt Naliwatan, at of more than 4,230. From these point less than 1,500 feet on passes locate lower group of mountains forms the we and 2,000 feet. Near the west coast ern part around Biliran Strait, uplan lower slopes are fairly regular; cut most of the island, slopes below 500 than 20%. Most of these slopes are u feet are too steep to cultivate. Abo
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Cross-Country Movement: Most of isl
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ts ds on	Observation: Excellent views of lowland south of Tacloban	Natural Cover: Almost no cover on plains around

NORTHEASTERN HILLS AND MOUNTAINS	seaward side of the uplands is borde mangrove swamps. Coastal lowlands ar swamps are covered by grass or woods. southwest of Tacloban. Coconut palms Tacloban. Interior is mostly forest Coastal Features and Lowlands: The s mostly rocky with sand beaches at sma patches of lowlands, steep slopes bor prominent rocky headlands. From Kana shore is bordered by mangrove swamp. low hills,with small areas of flat gr swamps, or descend directly to the se ground inland from the mangroves is i part,very low hills. From Anibong Po sand beach backed by broad coastal fl hills west of Tacloban; flats are in palms; some parts very poorly drained Hills and Mountains: Except for the entire area is rough mountains and hi 150 to more than 600 feet in altitude tween 1,400 and 2,300 feet. Nearly a very sharp narrow summits. Slopes ar 25%. Generally slopes meet the surro angles. Only locally on the southwes alluvial fans form a transition zone tween the plains and the steep hills. walled and very narrow. To the south come wider, and more open with some we Central part of the uplands is densel areas of brush and cogon grass with s and some trees. Rivers: Largest rivers flow through During the dry season most are probab than 150 feet wide except near their remainder of the area streams are sho the narrow lowlands. Streams subject

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b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

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SAMAR AND LEYTE(P.I.) LEYTE(P.I.) TERRAIN APPRECIATION GENERAL FEATURES

Area Number and Name	Topography[a/b/]	Movement[c/d/]	Observation and Concealment[a/]	Cover
	Reliability: Northwest peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte and adjacent islands, poor.			
3 NORTHEASTERN LOWLAND	General: A broad plain, most extensive lowland on Leyte, stretches from Carigara Bay across the northeast corner of the island to the east coast. The wider eastern part is nearly flat and featureless except for a few hills. Plain is bordered on the northeast by the steep hills of Area 2. The southwestern side of the lowland is composed of dissected plains which slope away from the high central range (Area 4). The slightly lower more poorly-drained areas near some parts of the coast and near the larger rivers are usually irrigated rice paddies. Remainder of the plain is chiefly cultivated to corn, coconuts and hemp; some large areas of cogon grass, especially near the east coast. Coastal Features: The coast facing Carigara Bay is regular with broad very shallow indentations between short, low rounded promontories. The sand beaches bordering most of the shore have an average width of nearly 500 feet at low tide and of about 20 feet at high tide. The beach is interrupted locally by several small stretches of mangrove, usually at river mouths. The east coast, except for two small rocky points, is bordered by sand beach fringed by coconut palms and bushes. Interior: The major portion of the area is a nearly featureless plain which probably nowhere exceeds 100 feet in altitude. Surface is flat or gently undulating. Plain is interrupted in a few places by prominent hills. A cluster of about 8 hills lies in the northeast corner near Carigara Bay. Five small peaks on north and west sides of the group are less than 20 feet above sea level; the remainder are between 300 and 550 feet. Slopes are moderately steep, cut by a few small ravines; gently sloping alluvial fans on the south and east sides. Several isolated hills and ridges with sharp summits rise abruptly north and northeast of Pastrana. A few small but prominent hills rise near the coast north of Tolosa. Several hills 200 or more than 350 feet in altitude rise from the beach. The long steep-sided Catmon Hill north of Dulag has a maximum altitude of about 1,000 feet; one long low spur extending to the shore. Lake Bito, northwest of Abuyog is partly bordered by very steep hills more than 500 feet high. Western part of area rises gradually from the low flat land as a broad gently sloping plain up to the base of steeper slopes of volcanic peaks (Area 4). Slopes are 2 to 5%. Surface is somewhat irregular; dissected by gullies and small valleys 10 to more than 150 feet deep. A few of the principal valleys are probably at least 300 feet deep. Gully sides are generally very steep with slopes of 30 to 100%; valley bottoms are generally narrow. Rivers: Many streams and small river; most head in the high central ranges (Area 4) and empty into Carigara Bay or Leyte Gulf. Most streams are 15 to 100 feet wide and, except during periods of high water, are generally only a few feet deep. The Binahaan and Marabang, two of the largest rivers, are more than 200 and 150 feet wide respectively near their mouths and are only slightly narrower at inland boundary of the area; depths commonly 3 or 4 feet. Stream gradients are generally low, although small falls and rapids are encountered near the west margin. Streams crossing gullied plains in western part flow in deep narrow valleys; across the flats, channels are very shallow. River beds are mostly sand, gravel and some silt with coarse material increasing upstream. Only at mouths are channels predominantly silt and clay. Commonly bars of sand or silt nearly close the river mouths.	General: Easy movement possible over most of area. Deep narrow ravines in western part are obstacles to north-south movement. Rice paddies, wet swampy ground, and larger rivers are most serious obstacles in remainder of area. Sandy clay soil provides fairly good footing in remainder of area. Existing Roads and Trails: Surfaced roads connect Carigara and Barugo to Palo and other large towns on eastern and southern parts of the plains. Numerous cart roads and trails connect small villages; probably not suitable for all-weather use without improvement. Cross-country Movement: Good sand beaches permit landings at many points on both coasts; in most places wheeled vehicles can easily drive from beaches to the roads. Topography of the broad flat plains is generally suitable for rapid deployment of mechanized units. Earth dikes around paddies are obstacles. Sloping plains on west side of area can be used by mechanized equipment. Very deep steep-sided parallel valleys and ravines which dissect them are barriers to north-south movement. Few can be crossed without construction of dug-ways or bridges. Rivers: Principal rivers crossing broad flat plains fordable except near mouths. Numerous smaller streams fordable, generally with some difficulty; unfordable during and after long heavy rains. Where rivers are cut into the sloping plains, difficulties of fording or bridging are increased by steepness of valley sides and lack of broad valley bottoms. In periods of long heavy rain, rivers and streams issuing from narrow valleys may flood parts of the lowlands making them impassable for mechanized vehicles.	Observation: Views are fairly good on lowlands; limited by lack of relief and locally by vegetation. Observation good from some parts of sloping plains. Isolated hills and ridges and bordering uplands provide excellent observation points. Aerial observation is excellent. Concealment: Concealment for large units lacking. Brush patches, scattered groups of trees and incised stream banks provide some concealment for small troop units.	Natural Cover: No cover for large units of men and vehicles. Most of area can be brought under fire from bordering mountains. Low embankments, stream banks and isolated hills afford cover for personnel. Deep ravines offer good cover, but very steep walls commonly make them almost inaccessible. Artificial Cover: Fox holes can be excavated almost anywhere. In broad low plains, excavations in flat poorly-drained ground near rivers and near many parts of coast will fill with water and are endangered by floods. On sloping plains, ground better drained and flood danger remote. Cut-and-cover shelters can be excavated on sloping plains. Some sites for cave shelters on isolated hills and parts of sloping plains.
4 CENTRAL HIGHLANDS	General: The belt of rugged steep-sided volcanic mountains extending unbroken from Bilaran Strait through central Leyte can be roughly divided into two parts: the short range forming the peninsula north of the Ormoc-Pinamopoan road and the long higher range of volcanic peaks south of the road. Mountains of Areas 7 and 8 form extension of range to south. Most of area is heavily forested. Coastal Features: Shore around the "Biliran Peninsula" is slightly irregular with many small rocky points separated by small shallow bays which are fronted by mangrove, sand, or cobblestone beach. Coastal plain is lacking. Mountain slopes ascend abruptly almost from the water's edge. Coast bordering Camotes Sea is fairly regular. Mountains: North of the Ormoc-Pinamopoan road. At the northern end of the peninsula, most altitudes range from 1,500 feet to more than 2,200 feet; maximum altitude is about 2,268 feet. In central and eastern part summits are narrow and slopes are very steep; commonly 25 to 40%. Mountain sides cut by many steep rocky gullies. Mt Pacdahauan reaches an altitude of about 2,085 feet within half a mile of the coast. On western margin of peninsula, summits are lower, slopes generally less steep. The mountains decrease in altitude southward; in the vicinity of Pinamopoan the range is generally less than 700 feet above sea level. Slopes are commonly less than 25%; ravines are more open and less steep. South of Ormoc-Pinamopoan road country rises rapidly to rugged volcanic peaks, the highest mountains on Leyte. The central range is generally between 2,500 and 4,000 feet in altitude. Alto Peak and a peak south of Mt Lobi reach maximum altitudes of 4,400 and 4,460 feet respectively. From the Ormoc-Pinamopoan road to the latitude of Dulag the range has a well defined NW-SE trend. To the south the range spreads out and the crest line is no longer well-defined. Smaller mountains parallel the west side of the main range. Lake Danao is enclosed in an ill-defined intermontane valley. On the east side the steep slopes of the main range descend directly to the plains of Area 3. The lowest part of the slopes are commonly gentle, less than 20%, but the middle and upper slopes steepen rapidly to 30 or 40%. The mountain sides are furrowed by deep narrow ravines and gullies. No recently active volcanoes are reported on Leyte, but smoking vents, "mud pots", and mineralized hot springs are common west of Burauen. On the extreme southwest corner of the area, a few cliffs and terraces of limestone border the seaward side of the mountains. Rivers: Most streams are short with steep gradients. Some flow only during periods of heaviest rains as normal rainfall disappears into the porous bedrock. Streams subject to occasional flash floods; most common in winter. Several streams on the west side of the range have largely underground courses. Only three large streams cross the high central range. The northernmost, the Binahaan heads in Lake Danao.	General: Unbroken barrier unsuitable for movement of mechanized units. Stony clay soil generally provides poor footing. Existing Roads and Trails: Good surfaced road from Ormoc (Area 5) crosses the range at its lowest point southwest of Pinamopoan. Winding mountain road crosses range from Baybay (Area 7) to Abuyog (Area 3) near southern end of area. Roads probably surfaced and suitable for all weather use; both are easily blocked and hard to repair. Only three trails known to cross the range: two from northern part of Area 3 to valley above Ormoc (Area 5); a third from Burauen (Area 3) to Ormoc Bay (Area 5). Several short cart tracks and trails enter both sides of range but do not cross it. Most cannot be used by motorized equipment without considerable construction. Cross-country Movement: Area is largely impassable for mechanized equipment except on roads; movement in many parts is very difficult even for foot troops. Steep dissected slopes, narrow rocky valleys, and tangled vegetation are principal obstacles. Roads and trails across mountains follow only good routes across the area. Rivers: Most streams draining the area are fordable at many points during dry weather. Flash floods and sudden rapid rises in water level may render them difficult to cross, some impassable, during and for a considerable time after long, hard rains.	Observation: High mountains provide lookout point over the lowlands to east, but views commonly obstructed by clouds or dense vegetation. Within the mountains, forest cover and irregular dissected topography limit observation. Concealment: Broken dissected topography and dense vegetation give good concealment for fairly large units in most parts of the area.	Natural Cover: Rocky spurs, ravines, and valleys throughout the area provide abundant cover for troops. Artificial Cover: Most slopes rocky and steep, and soil depth variable, but sites for fox holes can be found on lower parts of most slopes. Ground commonly soft, wet, and subject to slumping. Locally soil on lower slopes may be deep enough for cut-and-cover shelters; in a few places, for cave shelters. Timber for supports available.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

(continued)

SAMAR AND LEYTE(P.I.)

	Reliability: Northwest
Area Number and Name	Topography[a]
3 NORTHEASTERN LOWLAND	General: A broad plain, most extensive l from Carigara Bay across the northeast co east coast. The wider eastern part is ne except for a few hills. Plain is bordered steep hills of Area 2. The southwestern posed of dissected plains which slope awa (Area 4). The slightly lower more poorly of the coast and near the larger rivers a paddies. Remainder of the plain is chief coconuts and hemp; some large areas of co east coast. Coastal Features: The coast facing Carig very shallow indentations between short, The sand beaches bordering most of the sh nearly 500 feet at low tide and of about beach is interrupted locally by several s usually at river mouths. The east coast, points, is bordered by sand beach fringed Interior: The major portion of the area which probably nowhere exceeds 100 feet i or gently undulating. Plain is interrupt

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LEYTE (P.I.) TERRAIN AP

peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte and

/b/	Movement c/d/
owland on Leyte, stretches rner of the island to the arly flat and featureless l on the northeast by the side of the lowland is com- y from the high central range -drained areas near some parts re usually irrigated rice ly cultivated to corn, gon grass, especially near the ara Bay is regular with broad low rounded promontories. ore have an average width of 20 feet at high tide. The mall stretches of mangrove, except for two small rocky by coconut palms and bushes. is a nearly featureless plain n altitude. Surface is flat ed in a few places by promi-	General: Easy movement possible over most of area. Deep narrow ravines in western part are obstacles to north-south movement. Rice paddies, wet swampy ground, and larger rivers are most serious obstacles in remainder of area. Sandy clay soil provides fairly good footing in remainder of area. Existing Roads and Trails: Surfaced roads connect Carigara and Barugo to Palo and other large towns on eastern and southern parts of the plains. Numerous cart roads and trails connect small villages; probably not suitable for all-weather use without improvement. Cross-country Movement: Good sand beaches permit landings at many points on both coasts; in most places wheeled vehicles can easily drive from beaches to the roads. Topography of the broad flat plains is generally suitable for

PRECIATION GENERAL FEATURES

adjacent islands, poor.		
	Observation and Concealment[a/]	Cover
	Observation: Views are fairly good on lowlands; limited by lack of relief and locally by vegetation. Observation good from some parts of sloping plains. Isolated hills and ridges and bordering uplands provide excellent observation points. Aerial observation is excellent. Concealment: Concealment for large units lacking. Brush patches, scattered groups of trees and incised stream banks provide some concealment for small troop units.	Natural Cover: No cover for large units of men and vehicles. Most of area can be brought under fire from bordering mountains. Low embankments, stream banks and isolated hills afford cover for personnel. Deep ravines offer good cover, but very steep walls commonly make them almost inaccessible. Artificial Cover: Fox holes can be excavated almost anywhere. In broad low plains, excavations in flat poorly-drained ground near rivers and near many parts of coast will fill with water and are endangered by floods. On sloping plains, ground better drained and flood danger re-

	nent hills. A cluster of about 8 hills l near Carigara Bay. Five small peaks on n group are less than 20 feet above sea lev 300 and 550 feet. Slopes are moderately ravines; gently sloping alluvial fans on Several isolated hills and ridges with sh north and northeast of Pastrana. A few s near the coast north of Tolosa. Several feet in altitude rise from the beach. Th Hill north of Dulag has a maximum altitud long low spur extending to the shore. La is partly bordered by very steep hills Western part of area rises gradually from gently sloping plain up to the base of st peaks (Area 4). Slopes are 2 to 5%. Sur dissected by gullies and small valleys 10 A few of the principal valleys are probab Gully sides are generally very steep with bottoms are generally narrow. Rivers: Many streams and small river; most ranges (Area 4) and empty into Carigara Ba streams are 15 to 100 feet wide and, excep water, are generally only a few feet deep. two of the largest rivers, are more than respectively near their mouths and are onl depths commonly 3 or 4 feet. Stream gradi rapids are encountered near the west margi part flow in deep narrow valleys; across mostly sand, gravel and some silt with coa channels predominantly silt and clay. Co mouths.
4 CENTRAL HIGHLANDS	General: The belt of rugged steep-sided unbroken from Bilaran Strait through centr divided into two parts: the short range of the Ormoc-Pinamopoan road and the long peaks south of the road. Mountains of Are range to south. Most of area is heavily Coastal Features: Shore around the "Bilir regular with many small rocky points separ which are fronted by mangrove, sand, or co plain is lacking. Mountain slopes ascend water's edge. Coast bordering Camotes Sea Mountains: North of the Ormoc-Pinamopoan of the peninsula, most altitudes range fro 2,200 feet; maximum altitude is about 2,26 ern part summits are narrow and slopes are 40%. Mountain sides cut by many steep roc

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Sloping plains on west side of area can be used by mechanized equipment. Very deep steep-sided parallel valleys and ravines which dissect them are barriers to north-south movement. Few can be crossed without construction of dug-ways or bridges.
Rivers: Principal rivers crossing broad flat plains fordable except near mouths. Numerous smaller streams fordable, generally with some difficulty; unfordable during and after long heavy rains. Where rivers are cut into the sloping plains, difficulties of fording or bridging are increased by steepness of valley sides and lack of broad valley bottoms. In periods of long heavy rain, rivers and streams issuing from narrow valleys may flood parts of the lowlands making them impassable for mechanized vehicles.

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ky gullies. Mt Pacdahauan

General: Unbroken barrier unsuitable for movement of mechanized units. Stony clay soil generally provides poor footing.
Existing Roads and Trails: Good surfaced road from Ormoc (Area 5) crosses the range at its lowest point southwest of Pinamopoan. Winding mountain road crosses range from Baybay (Area 7) to Abuyog (Area 3) near southern end of area. Roads probably surfaced and suitable for all weather use; both are easily blocked and hard to repair. Only three trails known to cross the range: two from northern part of Area 3 to valley above Ormoc (Area 5); a third fro

mote. Cut-and-cover shelters can be excavated on sloping plains. Some sites for cave shelters on isolated hills and parts of sloping plains.

Observation: High mountains provide lookout point over the lowlands to east, but views commonly obstructed by clouds or dense vegetation. Within the mountains, forest cover and irregular dissected topography limit observation.
Concealment: Broken dissected topography and dense vegetation give good concealment for fairly large units in most parts of the area.

Natural Cover: Rocky spurs, ravines, and valleys throughout the area provide abundant cover for troops.
Artificial Cover: Most slopes rocky and steep, and soil depth variable, but sites for fox holes can be found on lower parts of most slopes. Ground commonly soft, wet, and subject to slumping. Locally soil on lower slopes may be deep enough for cut-and-cover shelters; in a few places, for cave shelters. Timber for supports available

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after long, hard rains.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

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y impassable for vement in many parts Steep dissected d vegetation are cross mountains	
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(continued)

RECONNAISANCE TOPOGRAPHIC MAP OF
NORTHWESTERN PENINSULA, LEYTE ISLAND

NATIONAL DEVELOPMENT COMPANY
PETROLEUM SURVEY

(Scale approximately 1:150,000)

0 1 5 10 km.

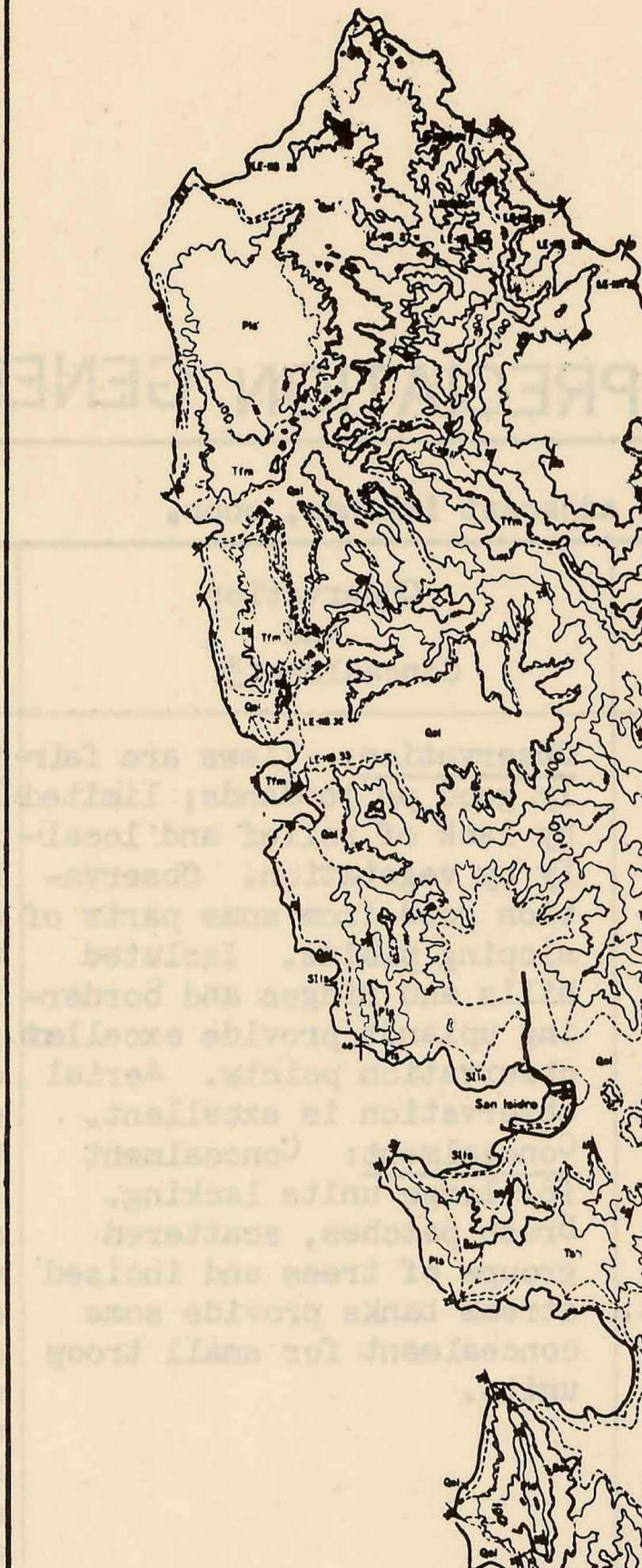
Contour interval = 50 meters

NOTE: This map is a copy of a preliminary geologic map made on the scale 1:50,000 and bears same abbreviations and symbols not pertaining to the topography, drainage or culture.



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LEYTE TERRAIN A



APPRECIATION [redacted] SAMAR

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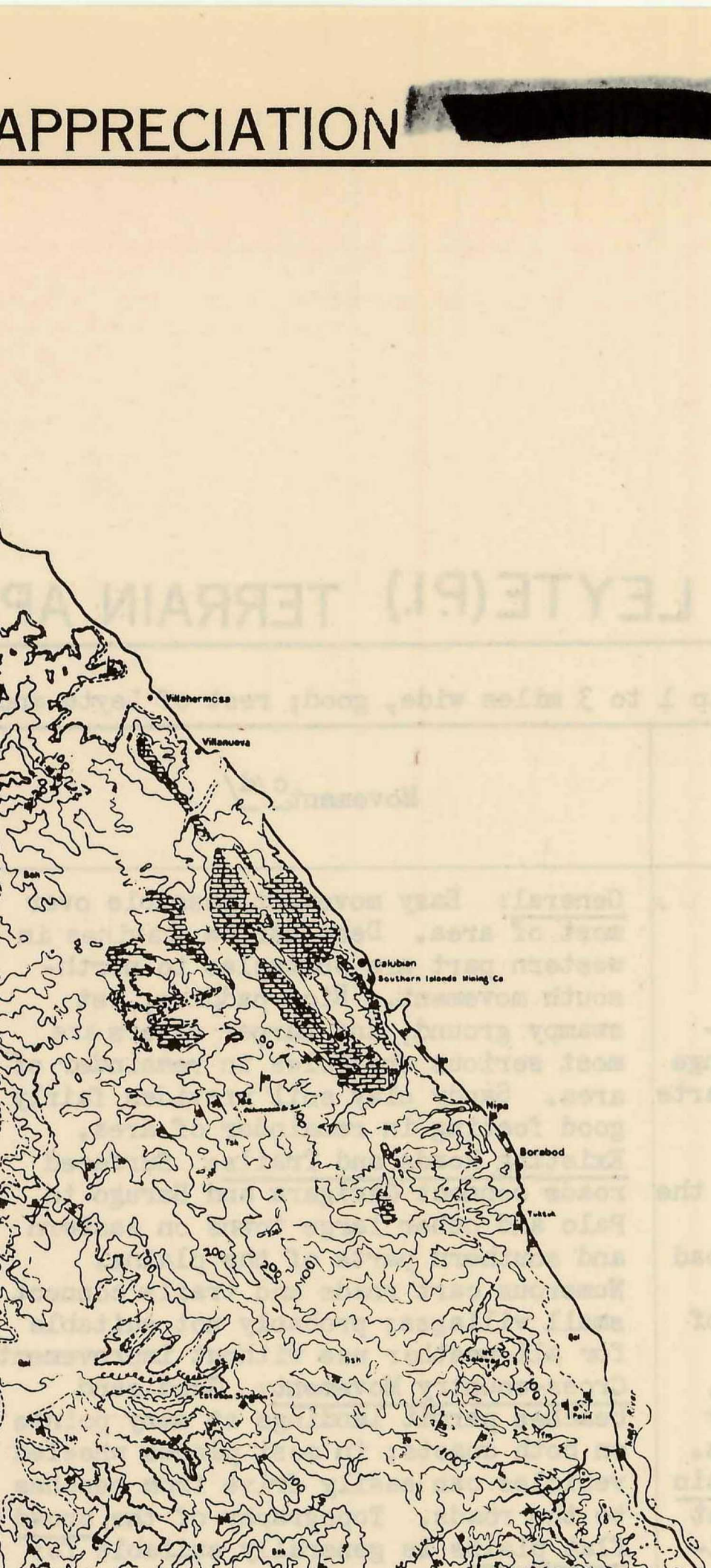
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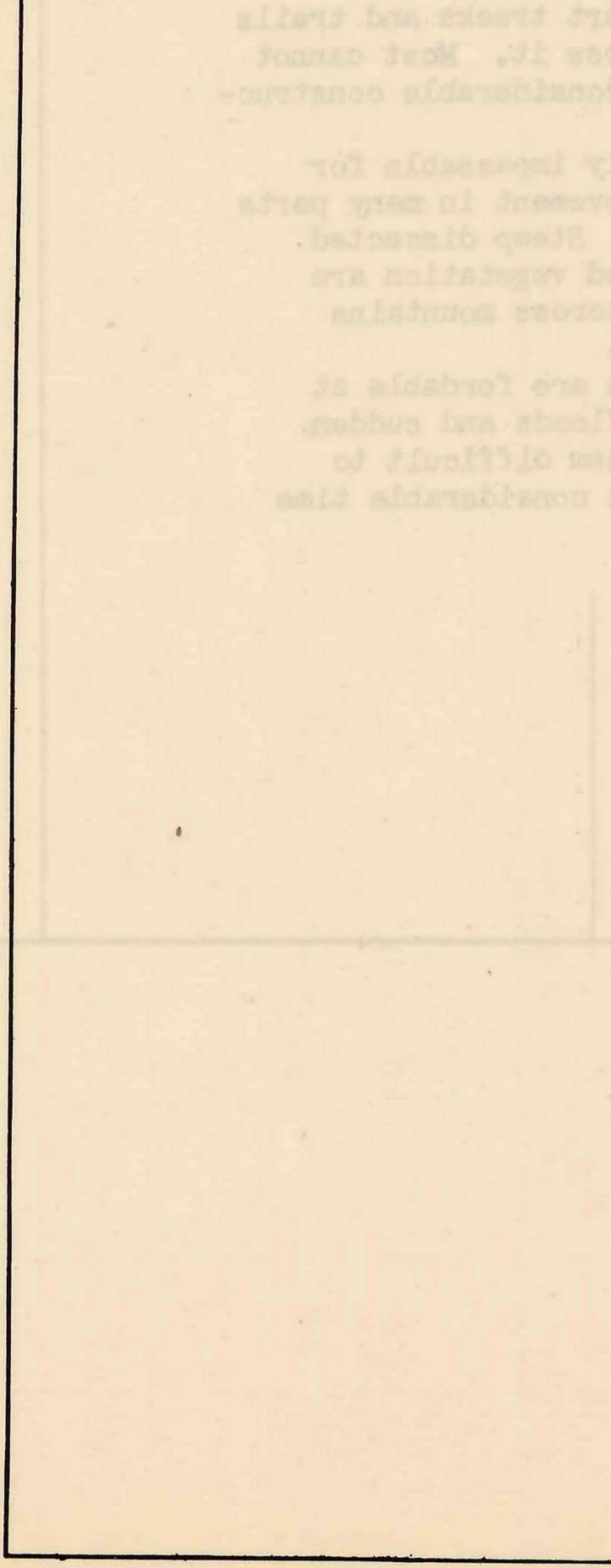
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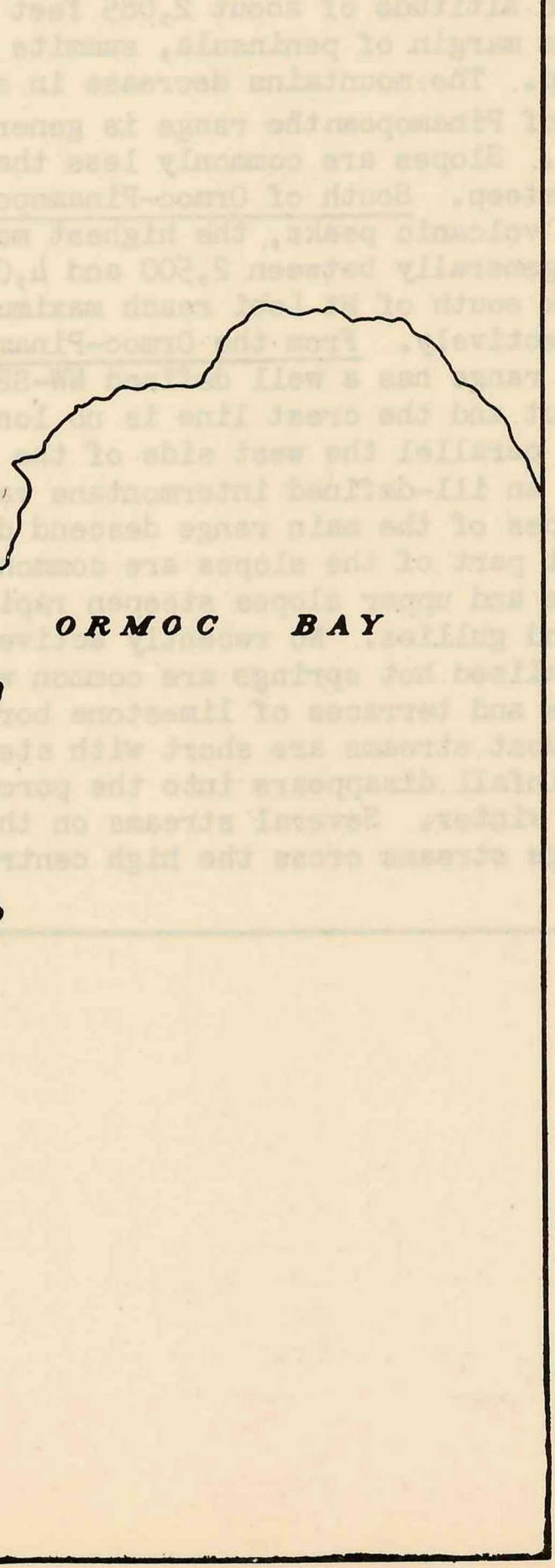
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Palompon
Merida


ORMOC BAY

Reliability: Northwest peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte and adjacent islands, poor.

Area Number and Name	Topography [a/b/]	Movement [c/d/]	Observation and Concealment [a/]	Cover
5 ORMOC BAY-LEYTE BAY CORRIDOR	General: Broad flat flood plains of the Leyte and Naga Rivers, the Pagsangahan River plain, and the adjacent alluvial fans together with the intervening narrow zone of low rough hills form a corridor between the high volcanic mountains (Area 4) in central Leyte and the uplands of the northwest peninsula (Area 6). Wooded tracts in several sections, but much of the area is cultivated or covered by cogon grass. Lowlands: The plain of the Naga and Leyte Rivers extends southeast from the head of Leyte Bay. Mangrove swamps bordered by wide mud flats exposed at low tide line the coast. Salt-water swamps probably border the Naga River for more than 3 1/2 miles upstream. Plains generally flat; better drained parts away from the river are under cultivation. Lowland bordered by hills a few hundred feet high. The Pagsangahan River has broad flat valley extending 8 to 10 miles inland from Ormoc. Broad gently sloping plains rise at grades of 2 to 5 degrees from the river or coastal flats on the east side of Ormoc Bay to the central highlands (Area 4). Slopes are slightly irregular; broken at intervals of 1/2 to 2 miles by steep-sided brush-filled ravines 50 to 300 feet deep. Uplands: Narrow belt of irregular hills and ridges separate the two lowlands. Altitudes are generally less than 300 feet. Summits mostly rounded. Slopes moderate, commonly 10 to 15%. Hills merge without marked topographic break with the uplands to east and west. Rivers: The Naga River is the largest on the north coast of Leyte; tidal in its entire course across the lowlands; generally more than 6 feet deep at low tide. Mouth commonly obstructed by sand bars. The Pagsangahan River empties into Ormoc Bay through several distributaries which flow across a small mangrove-covered deltaic plain. The Pagsangahan is broad and only locally more than a few feet deep. Stream gradient is fairly low in lowlands. Other streams in the area are small. Most have moderate to steep gradients except in lower courses near mouths or near junction with principal tributaries. All are subject to floods during the rainy season.	General: Most of the area permits use of mechanized equipment. Movement, however, is locally difficult. Wide mangrove swamps are barriers to landings except along shore south of Ormoc where coast is fronted by sand beach. Wet poorly drained clay soil gives poor footing in lowlands. Footing slightly better in higher better-drained parts of area. Existing Roads and Trails: Good road crosses the east side of area from Ormoc to Pinamopoan (Area 4); road from Palompon (Area 6) joins Ormoc road near center of area. Roads reported surfaced; partly suitable for all-weather use. Cross-Country Movement: In most places river plains can be used by mechanized units during dry weather. Danger from floods is considerable, however, and there are areas of perennially wet, poorly drained ground which will hamper movement. Mechanized units can maneuver on gently sloping plains which rise on east side of the Pagsangahan River and on east coast of Ormoc Bay, but southeast-northwest movement is obstructed by the deep parallel ravines which generally can be crossed only by cutting dugways or by bridging. Low ridges forming divide between Leyte and Ormoc Bay are obstacles, but in some places can be crossed by tanks. Rivers: The Naga and Leyte Rivers are unfordable in the lowlands. The Pagsangahan probably fordable locally for more than 5 miles inland even at low tide; upper reaches fordable at many points. Streams which cut the sloping plains are subject to sudden floods; deep, steep-sided narrow rocky channels are obstacles at all seasons.	Observation: Ground observation is fairly good from many points near the upper margin of the sloping plains and from the low ridges which cross the north-central part, although views locally limited by topographic irregularities and dense vegetation. Aerial observation generally good. Concealment: Extensive areas under cultivation or covered by cogongrass give no concealment except to a few scattered troops. High brush and trees on parts of hills, sloping plains and valley flats give best concealment in the area.	Natural Cover: Minor topographic irregularities, low hills, and ridges around margins and across the central divide between the rivers, provide some cover for men and machines, although positions commonly can be enfiladed from bordering mountains of Areas 4 and 6. Lower parts of plain and river flats exposed to fire; only scattered cover available for troops. Artificial Cover: Valley flats largely unsuitable; excavations 2 or 3 feet deep will commonly fill with water. Fox holes and protected shelters can be excavated on many parts of sloping plains and hills.
6 NORTHWESTERN PENINSULA	General: Rough broken terrain increasing in altitude from low hills and terraces in the north to high hills and steep rocky ridges in the south. Northern part of area largely covered by cogon grass or under cultivation. To south, forests become denser while grassland and cultivated areas progressively decrease. Coastal Features: Narrow irregular lowlands or low hills lie behind the sand or shingle beaches which border most of the northeast side of the area. For a limited distance along the beach near Calubian there are almost vertical limestone cliffs. On west coast north of San Isidro Bay terraces 50 to 100 feet high rise abruptly from the sea. The rest of the west coast is fairly irregular, indented by a series of shallow mangrove-bordered bays separated by rocky limestone ridges. Along Ormoc Bay steep hills lie behind the narrow beaches. Interior: Northern part. Area north of latitude of Arevalo Bay is chiefly low rolling hills and broad valleys. Altitudes generally less than 600 feet, although ridge behind Calubian terminates in a 1,000-foot peak. At the extreme northern end of the area is a small rough-surfaced limestone plateau 4 or 5 square miles in area; altitude about 250 feet. Plateau bordered on north and west by broad terraces less than 100 feet high. Remainder of hills are round or flat-topped with moderate slopes, generally less than 10%; locally some limestone cliffs. Valleys are open with flat floors. In central part of area ground becomes higher and rougher from north to south. Amount of land under cultivation becomes less from north to south. Average altitudes increase from 500 to more than 1,000 feet. Hill-land ridge tops commonly rounded; many are narrow; some have rocky jagged crests. Slopes become steeper and more rugged, range from 15 to 25%. Some asymmetrical limestone ridges with moderate to steep west slopes and very steep, locally cliffed east slopes cross southwest part of area. Valleys are narrow. Alluvial lowlands surround the small bays; are bordered by low steep hills and ridges. The southern part, south of the Palompon road, is highest and most rugged part of the peninsula. A central core of high rugged hills has an average altitude of more than 1,300 feet; culminates in Mt Maanga which attains an altitude of 1,955 feet. The high hills commonly have narrow summits with rocky peaks and sharp ridge crests. Slopes commonly are between 20 and 35%. Some prominent limestone ridges with numerous cliffs on east-facing slopes. On both sides of the central core is a belt of lower hills generally less than 1,000 feet high with slopes of 5 to 20%. Valleys are deep and narrow. Low benches of raised coral reefs or low alluvial plains locally lie between the hills and the sea on the southwest. Steep-sided hills descend almost directly to shore on side facing Ormoc Bay. Rivers: Rivers are short and small; most have moderate to steep gradients. Some are intermittent. Streams are subject to rapid increases in volume during the rainy season; occasional flash floods.	General: In most of the area, movement of mechanized units is difficult or impossible. The lower, more open and rolling topography in the northern part permits some use of mechanized equipment. South-central part of peninsula has gravelly soil which provides fairly good footing. In remainder of area footing on clay soil is poor when wet. Existing Roads and Trails: Partly surfaced road, probably suitable for all-weather use, extends from Palompon across the hills to Area 5. Trails connect most of coastal towns; need improvement for all-weather use. Several trails cross the area. Good trail from San Isidro Bay to Leyte Bay probably could be used by motorized equipment with some improvement. Cross-country Movement: Central and southern portions of the peninsula are largely impassable without construction of roads; small coastal lowlands allow very limited movement. In many places rough topography does not permit deployment away from roads. Rough steep slopes, narrow valleys and some cliffs are principal obstacles. Much of northern end of peninsula probably can be used by tanks and half-tracks; a few parts may be suitable for wheeled vehicles. Rivers: During dry season perennial rivers can be forded almost anywhere. In rainy weather, streams commonly will be difficult to cross, some impassible during flash floods or sudden rises in water level.	Observation: Fairly good in rolling, cogon-covered terrain in northern part, although numerous irregularities are obstacles to ground observation. Both ground and aerial observation become increasingly poor to the south where thickness of forest increases, and terrain becomes rougher. Concealment: Open grass-covered hills in north give little concealment. Forested areas in central and southern sections give good concealment for troops.	Natural Cover: Rolling hilly northern part gives some cover for mechanized units. Ravines and rocky slopes provide abundant cover for men in central and southern parts. Valleys and coastal flats can be easily enfiladed from surrounding heights. Artificial Cover: In many parts of area, thin soil permits only very shallow excavations. In many places along coast and on lowlands at north end, hard coral rock underlies a few inches of soil. Belt of rough hills along southwest margin and hills back of Calubian have thin soil with hard rock commonly at or near surface. In central part of peninsula, soil cover generally deeper and fox holes can be excavated in many places. Protected shelters can be constructed in some parts of central hills.
7 SOUTHWESTERN PENINSULA	General: Southwestern peninsula of Leyte is rugged and mountainous. It merges on the north without strong topographic break with the high central ranges (Area 4) and on the east with the mountains of southeastern Leyte (Area 8). Poorly defined zones of lower hills and wider more continuous valleys form very rough natural boundaries. Coastal lowlands usually cultivated with some large areas of rice. Coconuts along the shore. Uplands largely forested; some cogon-covered areas on slopes bordering Sogod Bay. Coastal Features and Lowlands: Coast is fairly regular with a few scattered shallow indentations and small rounded promontories; mostly sand or gravel beach. Some sections are bordered by coral reefs. The narrow low finger of Taancan Point at the south tip of Leyte is mangrove across the base. Most of the area, from Baybay to Sogod (Area 8), has a small coastal lowland of variable width. Most extensive lowlands are the plain north and east of Baybay and the strip of lowland which extends from the vicinity of Inopacan for more than 25 miles to the south and is one to more than two miles wide. On remainder of the west and southwest coasts, lowlands are very narrow, interrupted in places by high hills or irregular ridges. Islands: A few very small islands lie close to the shore. The Cuatro Islands off Inopacan are small and hilly; all less than a square mile in area. The hilly island of Limasawa, off Taancan Point, has an altitude of more than 600 feet although it is less than 1/2 mile wide. Mountains: On the western side of the area uplands are mostly long sharp ridges trending south to southeast. Many summits are between 1,500 and 2,000 feet in altitude; maximum altitude in the northwest part is more than 3,700 feet. East of Bato high ridges interrupted by zone of low hills and larger more open valleys. Near coast between Bato and Maasin, limestone ridges are generally less than 500 feet in altitude. Most valleys are narrow and rocky; small open flats are present locally. On eastern side of area a few long ridges make terrain more rugged than on western side, however, prominent ridges reported east of Maasin and west of Malitbog. Slopes are very steep except on hills bordering Sogod Bay where the rise is gradual to the hilltops and generally less than 25%. Rivers: Rivers crossing coastal lowland on the west coast are generally 4 to 7 feet deep even at low water. Sand bars, however, make the mouths very shallow. In upland, rivers shallow rapidly with marked increase in gradients. On lowland, beds are sandy or pebbly with some silt and mud. Sogod Bay rivers unfordable. Except in rare quiet stretches, streams in mountains have rough bouldery beds. Occasional flash floods.	General: Barrier area; unsuitable for cross-country movement of mechanized units away from roads. Narrow bordering lowlands permit fairly free coastwise movement. Except for the swampy ground near Malitbog and areas in rice, soil of lowlands is somewhat sandy and provides fairly good footing. Footing poor on clay soil of mountains. Existing Roads and Trails: From Baybay, all-weather surfaced road crosses coastal flats and mountains (Area 4) to the east coast. Good coastal road from Baybay to Matalom. Roads north from Baybay and from Matalom to Sogod are fair and probably can be used in any weather by light traffic; require improvement for heavy traffic. Trail from Bato to Sogod Bay cannot be used by wheeled vehicles without considerable improvement; may be passable to tanks. Cross-country Movement: Coastal lowlands are only areas suitable for mechanized units. The fairly large, continuous plains on west coast permit easy deployment of vehicles away from roads although extensive movement is channelized roughly parallel to the coast. Scattered, fairly large areas of rice paddy and some swamps hamper movement in some parts of the lowlands. Along Sogod Bay movement away from roads is greatly restricted by narrowness of coastal flats. The mountainous interior is largely impassable to mechanized equipment; locally very difficult even for foot troops. Steep slopes, cliffs, and dense vegetation are principal obstacles. Rivers: The larger west-coast rivers are not fordable in their lower reaches even at low tide, but can be easily bridged. Smaller streams on west coast and most on Sogod Bay fordable.	Observation: Good view of coastal lowlands and nearby islands can be obtained from mountains where not obstructed by heavy forest cover. Rough topography and dense vegetation make observation poor in interior. Concealment: On coastal lowlands, open low character of most of the vegetation gives limited concealment for personnel; almost no concealment for mechanized units. Broken terrain and jungle give good concealment for troops in the mountainous sections.	Natural Cover: No cover for large units of men and vehicles on coastal lowlands. Stream banks, embankments around paddies, and isolated small hills give cover for personnel. West coast of Sogod Bay can be brought under fire from east side of Bay. Rough terrain of interior offers good cover; however, trail from Bato can be brought under fire at many points from surrounding heights. Artificial Cover: Fox holes dug in most parts of the lowlands will commonly fill with water. Most parts of uplands suitable except on sharp rocky ridges where bedrock lies at or near surface. Sides of excavations may need support to prevent slumping. Cave-shelter sites can be found on many slopes; abundant supply of timber for supports.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

(continued)

LEYTE (P.I.) TERRAIN APPRECIAT

Area Number and Name	Reliability: Northw Topography a/b
5 ORMOC BAY-LEYTE BAY CORRIDOR	General: Broad flat flood plains of the Pagsangahan River plain, and the adjacen the intervening narrow zone of low rough the high volcanic mountains (Area 4) in of the northwest peninsula (Area 6). Wo tions, but much of the area is cultivate Lowlands: The plain of the Naga and Ley from the head of Leyte Bay. Mangrove sw flats exposed at low tide line the coast border the Naga River for more than 3 1/ generally flat; better drained parts awa cultivation. Lowland bordered by hills The Pagsangahan River has broad flat val inland from Ormoc. Broad gently sloping to 5 degrees from the river or coastal f Ormoc Bay to the central highlands (Area irregular; broken at intervals of 1/2 to brush-filled ravines 50 to 300 feet deep Uplands: Narrow belt of irregular hills lowlands. Altitudes are generally less rounded. Slopes moderate, commonly 10 t marked topographic break with the upland Rivers: The Naga River is the largest c tidal in its entire course across the lo 6 feet deep at low tide. Mouth commonly The Pagsangahan River empties into Ormoc tributaries which flow across a small ma The Pagsangahan is broad and only locall Stream gradient is fairly low in lowland area are small. Most have moderate to s lower courses near mouths or near junctio All are subject to floods during the rai

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TION GENERAL FEATURES

west peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte

/	Movement[c/d/]
Leyte and Naga Rivers, the t alluvial fans together with hills form a corridor between central Leyte and the uplands oded tracts in several sec- d or covered by cogon grass. te Rivers extends southeast amps bordered by wide mud . Salt-water swamps probably 2 miles upstream. Plains y from the river are under a few hundred feet high. ley extending 8 to 10 miles plains rise at grades of 2 flats on the east side of 4). Slopes are slightly 2 miles by steep-sided . and ridges separate the two than 300 feet. Summits mostly o 15%. Hills merge without ds to east and west. on the north coast of Leyte; owlands; generally more than obstructed by sand bars. c Bay through several dis- angrove-covered deltaic plain. ly more than a few feet deep. ds. Other streams in the steep gradients except in ion with principal tributaries. iny season.	General: Most of the area permits use of mechanized equipment. Movement, how ever, is locally difficult. Wide man- grove swamps are barriers to landings except along shore south of Ormoc wher coast is fronted by sand beach. Wet poorly drained clay soil gives poor footing in lowlands. Footing slightly better in higher better-drained parts area. Existing Roads and Trails: Good road crosses the east side of area from Orm to Pinamopoan (Area 4); road from Palo pon (Area 6) joins Ormoc road near cent of area. Roads reported surfaced; part suitable for all-weather use. Cross-Country Movement: In most places river plains can be used by mechanized units during dry weather. Danger fro floods is considerable, however, and there are areas of perennially wet, poo drained ground which will hamper moven maneuver on gently sloping plains whic Pagsangahan River and on east coast o northwest movement is obstructed by th which generally can be crossed only by bridging. Low ridges forming divide are obstacles, but in some places can Rivers: The Naga and Leyte Rivers are The Pagsangahan probably fordable loc inland even at low tide; upper reaches Streams which cut the sloping plains a deep, steep-sided narrow rocky channel seasons.

SAMAR AND LEYTE (P.I.)

e and adjacent islands, poor.

	Observation and Concealment a/	Cover
	Observation: Ground observation is fairly good from many points near the upper margin of the sloping plains and from the low ridges which cross the north-central part, although views locally limited by topographic irregularities and dense vegetation. Aerial observation generally good. Concealment: Extensive areas under cultivation or covered by cogongrass give no concealment except to a few scattered troops. High brush and trees on parts of hills, sloping plains and valley flats give best concealment in the area.	Natural Cover: Minor topographic irregularities, low hills, and ridges around margins and across the central divide between the rivers, provide some cover for men and machines, although positions commonly can be enfiladed from bordering mountains of Areas 4 and 6. Lower parts of plain and river flats exposed to fire; only scattered cover available for troops. Artificial Cover: Valley flats largely unsuitable; excavations 2 or 3 feet deep will commonly fill with water. Fox holes and protected shelters can be excavated on many parts of sloping plains and hills.

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ment. Mechanized units can
ch rise on east side of the
f Ormoc Bay, but southeast-
ne deep parallel ravines
y cutting dugways or by
between Leyte and Ormoc Bay
be crossed by tanks.
e unfordable in the lowlands.
cally for more than 5 miles
s fordable at many points.
are subject to sudden floods;
ls are obstacles at all

6 NORTHWESTERN PENINSULA	General: Rough broken terrain increasi and terraces in the north to high hills south. Northern part of area largely c cultivation. To south, forests become cultivated areas progressively decrease. Coastal Features: Narrow irregular low the sand or shingle beaches which borde of the area. For a limiteddistance alo there are almost vertical limestone cli San Isidro Bay terraces 50 to 100 feet sea. The rest of the west coast is fai series of shallow mangrove-bordered bay ridges. Along Ormoc Bay steep hills li Interior: Northern part. Area north o chiefly low rolling hills and broad val less than 600 feet, although ridge behi 1,000-foot peak. At the extreme northe rough-surfaced limestone plateau 4 or 5 tude about 250 feet. Plateau bordered terraces less than 100 feet high. Rema flat-topped with moderate slopes, gener some limestone cliffs. Valleys are ope central part of area ground becomes hig south. Amount of land under cultivatio south. Average altitudes increase from Hill-land ridge tops commonly rounded; rocky jagged crests. Slopes become ste from 15 to 25%. Some asymmetrical lime steep west slopes and very steep, local southwest part of area. Valleys are na round the small bays; are bordered by l The southern part, south of the Palompo rugged part of the peninsula. A centra than 1,300 feet; culminates in Mt Maang commonly have narrow summits with rocky 20 and 35%. Some prominent limestone r sides of the central core is a belt of of 5 to 20%. Valleys are deep and narr locally lie between the hills and the s ly to shore on side facing Ormoc Bay. Rivers: Rivers are short and small; mo Streams are subject to rapid increases
7	General: Southwestern peninsula of Le It merges on the north without strong central ranges (Area 4) and on the east

ng in altitude from low hills
and steep rocky ridges in the
overed by cogon grass or under
denser while grassland and

lands or low hills lie behind
r most of the northeast side
ng the beach near Calubian
ffs. On west coast north of
high rise abruptly from the
rly irregular, indented by a
s separated by rocky limestone
e behind the narrow beaches.
f latitude of Arevalo Bay is
leys. Altitudes generally
nd Calubian terminates in a
rn end of the area is a small
square miles in area; alti-
on north and west by broad
inder of hills are round or
rally less than 10%; locally
n with flat floors. In
gher and rougher from north to
on becomes less from north to
500 to more than 1,000 feet.
many are narrow; some have
eeper and more rugged, range
estone ridges with moderate to
ly cliffed east slopes cross
arrow. Alluvial lowlands sur-
low steep hills and ridges.
on road, is highest and most

General: In most of the area, movemen
of mechanized units is difficult or
impossible. The lower, more open and
rolling topography in the northern pa
permits some use of mechanized equipm
South-central part of peninsula has
gravelly soil which provides fairly
good footing. In remainder of area
footing on clay soil is poor when wet
Existing Roads and Trails: Partly su
faced road, probably suitable for all
weather use, extends from Palompon
across the hills to Area 5. Trails
connect most of coastal towns; need
improvement for all-weather use. Sev
al trails cross the area. Good trail
from San Isidro Bay to Leyte Bay prob
ably could be used by motorized equip
ment with some improvement.
Cross-country Movement: Central and
peninsula are largely impassable with
small coastal lowlands allow very lim
places rough topography does not perm
roads. Rough steep slopes, narrow va
are principal obstacles. Much of nor
probably can be used by tanks and hal
may be suitable for wheeled vehicles.
Rivers: During dry season perennial
almost anywhere. In rainy weather, s
be difficult to cross, some impassibl
or sudden rises in water level.

al core of high rugged hills has an average altitude of more
ga which attains an altitude of 1,955 feet. The high hills
peaks and sharp ridge crests. Slopes commonly are between
ridges with numerous cliffs on east-facing slopes. On both
lower hills generally less than 1,000 feet high with slopes
row. Low benches of raised coral reefs or low alluvial plains
sea on the southwest. Steep-sided hills descend almost direct-
.
ost have moderate to steep gradients. Some are intermittent.
in volume during the rainy season; occasional flash floods.

yte is rugged and mountainous.
topographic break with the high
t with the mountains of south-

General: Barrier area; unsuitable fo
cross-country movement of mechanized
units away from roads. Narrow borde

nt rt ent. . r- - er- - -	Observation: Fairly good in rolling, cogon-covered terrain in northern part, although numerous irregularities are obstacles to ground observation. Both ground and aerial observation become increasingly poor to the south where thickness of forest increases, and terrain becomes rougher. Concealment: Open grass-covered hills in north give little concealment. Forested areas in central and southern sections give good concealment for troops.	Natural Cover: Rolling hilly northern part gives some cover for mechanized units. Ravines and rocky slopes provide abundant cover for men in central and southern parts. Valleys and coastal flats can be easily enfiladed from surrounding heights. Artificial Cover: In many parts of area, thin soil permits only very shallow excavations. In many places along coast and on lowlands at north end, hard coral rock underlies a few inches of soil. Belt of rough hills along southwest margin and hills back of Calubian have thin soil with hard rock commonly at or near surface. In central part of peninsula, soil cover generally deeper and fox holes can be excavated in many places. Protected shelters can be constructed in some parts of central hills.

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out construction of roads;
ited movement. In many
it deployment away from
lleys and some cliffs
thern end of peninsula
f-tracks; a few parts

rivers can be forded
streams commonly will
e during flash floods

or r- t-	Observation: Good view of coastal lowlands and nearby islands can be ob- tained from mountains where	Natural Cover: No cover for large units of men and vehicles on coastal lowlands. Stream banks, embankments

SOUTHWESTERN PENINSULA	eastern Leyte (Area 8). Poorly define wider more continuous valleys form ver Coastal lowlands usually cultivated wi Coconuts along the shore. Uplands lar covered areas on slopes bordering Sogo Coastal Features and Lowlands: Coast scattered shallow indentations and sma sand or gravel beach. Some sections a narrow low finger of Taancan Point at grove across the base. Most of the ar has a small coastal lowland of variabl lands are the plain north and east of which extends from the vicinity of Ino the south and is one to more than two the west and southwest coasts, lowland in places by high hills or irregular r Islands: A few very small islands lie Cuatro Islands off Inopacan are small square mile in area. The hilly island has an altitude of more than 600 fee 1/2 mile wide. Mountains: On the western side of the sharp ridges trending south to southea 1,500 and 2,000 feet in altitude; maxi part is more than 3,700 feet. East of by zone of low hills and larger more o tween Bato and Maasin, limestone ridges feet in altitude. Most valleys are na flats are present locally. On eastern make terrain more rugged than on weste ridges reported east of Maasin and wes steep except on hills bordering Sogod to the hilltops and generally less tha Rivers: Rivers crossing coastal lowla low water. Sand bars, however, make t with marked increase in gradients. Or Sogod Bay rivers unfordable. Except i bouldery beds. Occasional flash flood

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ground near Malitbog and areas in ri
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provides fairly good footing. Footi
poor on clay soil of mountains.

Existing Roads and Trails: From Bay
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al flats and mountains (Area 4) to t
east coast. Good coastal road from
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Cross-country Movement: Coastal low
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on west coast permit easy deployment
roads although extensive movement is
to the coast. Scattered, fairly lar
some swamps hamper movement in some
Sogod Bay movement away from roads i
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largely impassable to mechanized equ
cult even for foot troops. Steep sl
obstacles.

Rivers: The larger west-coast river
at low tide, but can be easily bridg
Sogod Bay fordable.

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n rare quiet stretches, streams in mountains have rough
ls.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

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not obstructed by heavy forest cover. Rough topography and dense vegetation make observation poor in interior.

Concealment: On coastal lowlands, open low character of most of the vegetation gives limited concealment for personnel; almost no concealment for mechanized units. Broken terrain and jungle give good concealment for troops in the mountainous sections.

around paddies, and isolated small hills give cover for personnel. West coast of Sogod Bay can be brought under fire from east side of Bay. Rough terrain of interior offers good cover; however, trail from Bato can be brought under fire at many points from surrounding heights.

Artificial Cover: Fox holes dug in most parts of the lowlands will commonly fill with water. Most parts of uplands suitable except on sharp rocky ridges where bedrock lies at or near surface. Sides of excavations may need support to prevent slumping. Cave-shelter sites can be found on many slopes; abundant supply of timber for supports.

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(continued)

SAMAR AND LEYTE (P.I.)

LEYTE (P.I.) TERRAIN APPRECIATION GENERAL FEATURES

Reliability: Northwest peninsula and coastal strip 1 to 3 miles wide, good; rest of Leyte and adjacent islands, poor.

Area Number and Name	Topography [a/] [b/]	Movement [c/] [d/]	Observation and Concealment [a/]	Cover
8 SOUTHEASTERN PENINSULA	General: High very rugged mountainous region which is the southern continuation of the high central ranges (Area 4). Coastal lowlands are small and scattered. The mountains present an unbroken barrier, although a zone of long valleys and lower hills forms a poor topographic corridor. Lowlands mostly cultivated to rice, coconuts, and other small crops. Mountains largely forested. Lower slopes near coast may be cultivated or grass-covered. Coastal Features and Lowlands: Coastline is somewhat irregular; indented by a few large bays and numerous small shallow coves. Along most of the coast, slopes rise directly from narrow rocky beaches or are separated from the sea by only very narrow discontinuous strips of flat ground; numerous rocky headlands. Small plains commonly found at mouths of large streams seldom extend more than 1/4 to 1/2 mile along the coast and a mile inland. Largest lowland faces Hinunangan Bay. The plain is nearly flat, locally undulating. In part, the lowland is separated from the sea by a group of 1,000-foot high hills which have extremely steep, locally cliffed, seaward slopes and moderately steep slopes facing the plain. Lowland is continued south from cove of Hinundayan by a narrow coastal strip which is in part rough and rocky, especially on south side of Mt Cabalian. Only other lowland of any importance lies near the head of Sogod Bay. It is formed by the coalescence of several river flats, which are covered mainly by rice paddies. Mountains: Throughout the area the mountains are high and steep; most altitudes are between 1,500 and 3,000 feet. Relief is commonly 1,000 to 2,000 feet; divides between headwaters of major streams usually have relief of less than 600 feet. In the eastern two thirds of the area mountain summits are irregular and generally narrow and rounded. Several of the highest retain a roughly conical shape. Slopes are commonly 10 to 30%; generally steepen gradually from base to crest. Mountain sides are cut by numerous narrow ravines with steep gradients and rocky bottoms. Mt Cabalian, occupying the large southeast promontory of the peninsula, is the most prominent peak. Its lower slopes are from 3 to 10% and increase regularly to more than 35% near the rocky summit. Below 1,000 to 2,000 feet altitude, slopes are partly cleared and cultivated, partly covered by cogon grass and rank second growth. In the western third of the peninsula from Panaon Strait nearly to the northwest corner of the area, conical peaks are very few and the topography is characterized by long ridges. Crests are commonly narrow, some very sharp and rocky. Sides are generally steep; slopes very irregular with sudden marked changesin gradient. Rivers: Most of streams draining area are short with extremely steep gradients. Very little water from the south slopes of Mt Cabalian reaches the sea in surface streams; the greater part sinks into the porous rocks and reaches the coast through underground channels. The mouth of the Malaga, largest river in the area, is partly blocked by a bar covered by 1 to 2 feet of water. Upstream for about a mile it is 2 to 5 feet deep at low tide.	General: Area unsuitable for mechanized units except for lowland around Hinunangan; difficult even for foot troops. Poor footing given by clay soil when wet; hampers movement. Existing Roads and Trails: Partly surfaced road follows large section of east coast; second class roads on east side of Sogod Bay. Roads connected by good trails to northern part of island; trails probably could be used by mechanized equipment with little improvement. Trail north from Sogod through belt of low mountains probably connects with Baybay-Abuyog road. Cross-country Movement: Use of mechanized units is possible within the limited area of the Hinunangan Lowland; diked rice paddies are obstacles. Movement is possible parallel to many parts of the coast, but commonly movement away from roads or trail is restricted to a few hundred feet. Remainder of area impassable for mechanized units; movement difficult even for foot troops. Trail from Sogod follows easiest known-route through interior to north part of island. Rugged terrain and dense vegetation are principle obstacles. Rivers: A few large rivers on Sogod Bay, Cabalian Bay, and the east coast probably difficult to ford in their lower reaches even at low tide. Most of the other streams probably can be forded at several points except after long protracted rains.	Observation: Numerous points on the uplands command large areas along coast, but on higher uncleared slopes, views almost completely obstructed by dense vegetation. Best views available on partly cleared lower slopes. Observation within mountains very poor. Concealment: In mountainous forested sections, concealment excellent. In cultivated areas on lower slopes and along coast, concealment poor except for scattered personnel.	Natural Cover: Except in the scattered coastal lowlands, rough terrain provides abundant cover for troops, even close to the coast. Artificial Cover: Many slopes too steep and rocky to permit excavations. Excavations in lowlands probably will fill with water. Fox holes can be excavated on some of the more gentle slopes near the coast. Some sites for protected shelters.
9 PANAON ISLAND	General: Long, narrow mountainous island with steep slopes commonly rising abruptly from the sea. Most of the area is heavily forested. Coastal Features and Lowlands: Coast is slightly irregular. Steep mountains rise abruptly from the sea; in places fronted by narrow cobblestone beaches or rocky headlands. On northeast and east sides, coastal plains are lacking except for isolated strips which usually lie behind beaches at heads of small coves. A narrow but almost continuous lowland extends along the southwest coast nearly to the village of San Francisco where it is terminated by a rocky ridge. Around San Francisco, a lowland extends for more than a mile along the coast and nearly a mile and a half inland. Terrain at north tip of island is fairly open with some areas of flat or rolling lowland interrupted by numerous low rounded hills. Mountains: In the central and southern parts, the mountains of Panaon are commonly more than 2,300 feet in altitude; maximum about 2,820 ft. near Mt Jinaunan in the center of the island. At the north end, altitudes drop to between 1,000 and 1,600 feet. Slopes are very steep; nearly everywhere more than 35% except at north end where they are more moderate. Mountain sides are cut by numerous deep narrow gullies. Most of mountains are covered by heavy timber. Few cultivated areas. Rivers: Streams are numerous but very small; nearly all are short and steep. Subject to sudden rises during the rainy season.	General: Barrier area unsuitable for mechanized units without construction of roads. Slipperiness and plasticity of stony clay soil when wet hampers movement. Existing Roads and Trails: Single trail around coast of island. Cross-country Movement: Narrow discontinuous strip of lowland on west side permits limited coastwise movement of mechanized units. Limited movement possible around Liloan at north end. Remainder of area difficult even for foot troops. Narrow valleys a mile or two long are only feasible routes to high rugged interior. Rivers: Streams on the island are probably all fordable at many points except when in flood.	Observation: Irregular rugged nature of terrain and dense forest cover makes observation difficult within the area. However, good observation points commanding surrounding sea and parts of Leyte mainland can be found at a few points where there are openings in vegetation. Concealment: In mountainous forested parts, concealment is excellent. In cultivated areas on lower slopes and along the coast concealment is poor except for scattered personnel.	Natural Cover: Rugged terrain with deeply cut slopes and numerous valleys offers good cover for troops. Artificial Cover: On slopes less than 20 to 25%, soil cover may be deep enough to permit excavation of fox holes. Best area is at north end around Liloan. A few sites for cave shelters can be found in hills around Liloan and locally in the mountains to the south of the town.
10 CAMOTES ISLAND	General: The three Camotes Islands are all relatively high and hilly; bordered in part by low bluffs, in part by mangrove. Hills are almost completely covered by grass or a rank tangle of brush and vines. Lower slopes and lowlands generally cultivated. Ponson Island: Is smallest and most easterly. Coastline is fairly regular; bordered by narrow band of mangrove around most of northeast tip and locally along the northwest coast. Bluffs 15 to 20 feet high generally fronted by sand beaches border the remainder of the island. A narrow strip of lowland lies inland between the coast and the hilly interior. At the northeast end it widens into small plain. Most of the island is occupied by a belt of hills 300 to 700 feet in altitude; average about 400 feet. Slopes are moderate, generally 15 to 20%. Rivers: The Bituca River on the southeast end of the island is only known perennial river in the Camotes. Other streams on Ponson Island are dry or only flow in small trickles for at least part of the year. In the wet season streams fill their channels to a width of from six to ten feet. Poro Island: Coastal Features: The south coast is formed mostly by a broad gravel beach rising gently to the mountain front. Beach is interrupted at a few points by steep bluffs; the highest, near Poro, is more than 100 feet above sea level. Gravel beach is flanked on southeast and west by belts of mangrove. Elsewhere raised coral reefs form flats terminating in coastal bluffs about 20 feet high; locally a few small areas of mangrove. The crest of the hills which occupy most of the island lies in the southern part. Hills rise abruptly from the south coast to altitudes of more than 1,250 feet. Slopes are commonly more than 40%; are dissected by several very deep narrow ravines. On the rest of the island slopes of the ridges rising to the crest are much lower, range from 3 to 15%. Small valleys cut in the slopes have open V shapes. No perennial streams. Valleys and ravines are filled with small torrents during rainy season. Pacijan Island: Aside from a few small sections of mangrove, the entire coast is bordered by steep bluffs 10 to 50 feet high; fronted by narrow sandy or gravelly beaches. A broad belt of gently undulating land extends inland from coast. This lowland, formed by raised coral reef with fine silty soil is mostly under cultivation. Near north end is Lake Lanao, a shallow brackish water lake surrounded by nipa swamps and mud flats. A group of rounded hills occupies most of the south and central parts of the island; restricts lowland to narrow band on southeast coast. Hills are 600 to 800 feet high; slopes gentle to moderate.	General: Low bluffs and mangrove swamps fronting nearly all the coasts probably are important obstacles for landings. The lowlands and parts of the hills can be used by mechanized units. Steeper, higher areas unsuitable. Most parts of islands have friable clay soil which when wet is difficult to move over. Existing Roads and Trails: Roads connect larger settlements on all three islands. Most of mileage surfaced and suitable for all-weather use. Cross-Country Movement: Except for very steep high hills in south-central Poro and Pacijan, mechanized units can move over most parts of the islands. Deep ravines, steep or rocky slopes will locally be serious obstacles to movement across the hilly areas. On Pacijan, Lake Lanao and its broad border of soft muddy ground probably must be by-passed. Rivers: Streams and dry ravines are obstacles to movement only during and for some time after heavy rains.	Observation: Good views of nearly all parts of lowlands can be obtained from high hills on Poro and Pacijan. Low irregular topography limits observation on most parts of Ponson. Concealment: No concealment for large units. Patches of brush, small ravines and valleys give concealment for personnel on hilly parts of islands.	Natural Cover: No cover for large units. Ravines and ridges give good cover for personnel in hilly areas. Lowlands can be brought under fire from hills; narrow beaches exposed to fire from the bluffs. Artificial Cover: Shallow soil cover which overlies hard coral rock makes excavations of fox holes difficult or impossible on many parts of low areas. In some parts of hills, soil deep enough for hasty fortifications. In a few places, conditions suitable for protected shelters.

a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE (P.I.)

Area Number and Name	Topography[a/b]
	Reliability: Northwest per
8 SOUTHEASTERN PENINSULA	General: High very rugged mountainous region continuation of the high central ranges (Area are small and scattered. The mountains prese although a zone of long valleys and lower hil graphic corridor. Lowlands mostly cultivated other small crops. Mountains largely foreste coast may be cultivated or grass-covered. Coastal Features and Lowlands: Coastline is dented by a few large bays and numerous small most of the coast, slopes rise directly from are separated from the sea by only very narro of flat ground; numerous rocky headlands. Sm found at mouths of large streams seldom exten mile along the coast and a mile inland. Larg Hinunangan Bay. The plain is nearly flat, lo part, the lowland is separated from the sea b high hills which have extremely steep, locall slopes and moderately steep slopes facing the continued south from cove of Hinundayan by a which is in part rough and rocky, especially Cabalian. Only other lowland of any importan of Sogod Bay. It is formed by the coalescenc which are covered mainly by rice paddies. Mountains: Throughout the area the mountains most altitudes are between 1,500 and 3,000 fe 1,000 to 2,000 feet; divides between headwate

LEYTE (P.I.) TERRAIN APPREC

insula and coastal strip 1 to 3 miles wide, good; rest of Leyte and adjacen

	Movement[c/d/]	
which is the southern 4). Coastal lowlands nt an unbroken barrier, ls forms a poor topo- to rice, coconuts, and d. Lower slopes near somewhat irregular; in- shallow coves. Along narrow rocky beaches or w discontinuous strips all plains commonly d more than 1/4 to 1/2 est lowland faces cally undulating. In y a group of 1,000-foot y cliffed, seaward plain. Lowland is narrow coastal strip on south side of Mt ce lies near the head e of several river flats, are high and steep; et. Relief is commonly rs of major streams n the eastern two thirds	General: Area unsuitable for mechanized units except for lowland around Hinunangan; difficult even for foot troops. Poor footing given by clay soil when wet; hampers movement. Existing Roads and Trails: Partly surfaced road follows large section of east coast; second class roads on east side of Sogod Bay. Roads connected by good trails to northern part of island; trails probably could be used by mechanized equipment with little improvement. Trail north from Sogod through belt of low mountains probably connects with Baybay-Abuyog road. Cross-country Movement: Use of mechanized units is possible within the limited area of the Hinunangan Lowland; diked rice paddies are obstacles. Movement is possible parallel to many parts of th away from roads or trail is restricted to a few h impassable for mechanized units; movement difficu from Sogod follows easiest known-route through in Rugged terrain and dense vegetation are principle Rivers: A few large rivers on Sogod Bay, Cabalia difficult to ford in their lower reaches even at l probably can be forded at several points except a	Observa points mand la coast, ed slop complet dense v views a cleared servati very po Conceal foreste ment ex vated a and alo poor ex personn

IATION GENERAL FEATURES

t islands, poor.

Observation and Concealment a/	Cover
tion: Numerous on the uplands com- rge areas along but on higher unclear- es, views almost ely obstructed by egetation. Best vailable on partly lower slopes. Ob- on within mountains or. ment: In mountainous d sections, conceal- xcellent. In culti- reas on lower slopes ng coast, concealment xcept for scattered el.	Natural Cover: Except in the scattered coastal low- lands, rough terrain pro- vides abundant cover for troops, even close to the coast. Artificial Cover: Many slopes too steep and rocky to permit excavations. Excavations in lowlands probably will fill with water. Fox holes can be excavated on some of the more gentle slopes near the coast. Some sites for protected shelters.

e coast, but commonly movement
undred feet. Remainder of area
lt even for foot troops. Trail
terior to north part of island.
obstacles.
an Bay, and the east coast probably
low tide. Most of the other streams
after long protracted rains.

	usually have relief of less than 500 feet. T of the area mountain summits are irregular an rounded. Several of the highest retain a rou steepen gradually from base to crest. Mounta and rocky bottoms. Mt Cabalian, occupying th prominent peak. Its lower slopes are from 3 t summit. Below 1,000 to 2,000 feet altitude, cogon grass and rank second growth. In the w northwest corner of the area, conical peaks a Crests are commonly narrow, some very sharp a sudden marked changesin gradient. Rivers: Most of streams draining area are sh south slopes of Mt Cabalian reaches the sea i and reaches the coast through underground cha partly blocked by a bar covered by 1 to 2 fee at low tide.
9 PANAON ISLAND	General: Long, narrow mountainous island wit rising abruptly from the sea. Most of the ar Coastal Features and Lowlands: Coast is slig mountains rise abruptly from the sea; in place cobblestone beaches or rocky headlands. On m coastal plains are lacking except for isolate lie behind beaches at heads of small coves. tinuous lowland extends along the southwest c village of San Francisco where it is terminat Around San Francisco, a lowland extends for m the coast and nearly a mile and a half inland of island is fairly open with some areas of f interrupted by numerous low rounded hills. Mountains: In the central and southern parts are commonly more than 2,300 feet in altitude ft. near Mt Jinaunan in the center of the isla altitudes drop to between 1,000 and 1,600 fee steep; nearly everywhere more than 35% except are more moderate. Mountain sides are cut by gullies. Most of mountains are covered by he vated areas. Rivers: Streams are numerous but very small; steep. Subject to sudden rises during the ra
10 CAMOTES ISLAND	General: The three Camotes Islands are all hilly; bordered in part by low bluffs, in pa almost completely covered by grass or a rank Lower slopes and lowlands generally cultivate Ponson Island: Is smallest and most easterly regular; bordered by narrow band of mangrove tip and locally along the northwest coast.

d generally narrow and ghly conical shape. Slopes are commonly 10 to 30%; generally in sides are cut by numerous narrow ravines with steep gradients e large southeast promontory of the peninsula, is the most o 10% and increase regularly to more than 35% near the rocky slopes are partly cleared and cultivated, partly covered by western third of the peninsula from Panaon Strait nearly to the are very few and the topography is characterized by long ridges. nd rocky. Sides are generally steep; slopes very irregular with hort with extremely steep gradients. Very little water from the n surface streams; the greater part sinks into the porous rocks annels. The mouth of the Malaga, largest river in the area, is t of water. Upstream for about a mile it is 2 to 5 feet deep		
th steep slopes commonly rea is heavily forested. ghtly irregular. Steep es fronted by narrow northeast and east sides, ed strips which usually A narrow but almost con- coast nearly to the ted by a rocky ridge. more than a mile along d. Terrain at north tip flat or rolling lowland s, the mountains of Panaon e; maximum about 2,820 and. At the north end, et. Slopes are very t at north end where they y numerous deep narrow eavy timber. Few culti- ; nearly all are short and ainy season.	General: Barrier area unsuitable for mechanized units without construction of roads. Slipperiness and plasticity of stony clay soil when wet hampers movement. Existing Roads and Trails: Single trail a round coast of island. Cross-country Movement: Narrow discontinuous strip of lowland on west side permits limited coastwise movement of mechanized units. Limited movement possible around Liloan at north end. Remainder of area difficult even for foot troops. Narrow valleys a mile or two long are only feasible routes to high rugged interior. Rivers: Streams on the island are probably all fordable at many points except when in flood.	Observa rugged and de makes within good o comman and pa can be points openin Conceal ous fo ment i tivate slopes conceal for sc
relatively high and rt by mangrove. Hills are tangle of brush and vines. ed. y. Coastline is fairly around most of northeast Bluffs 15 to 20 feet high	General: Low bluffs and mangrove swamps fronting nearly all the coasts probably are important obstacles for landings. The lowlands and parts of the hills can be used by mechanized units. Steeper, higher areas unsuitable. Most parts of islands have friable clay soil which	Observ nearly can be hills Low ir limits parts

ation: Irregular nature of terrain nse forest cover observation difficult the area. However, bservation points ding surrounding sea rts of Leyte mainland found at a few where there are gs in vegetation. lment: In mountain- rested parts, conceal- s excellent. In cul- d areas on lower and along the coast lment is poor except attered personnel.	Natural Cover: Rugged terrain with deeply cut slopes and numerous valleys offers good cover for troops. Artificial Cover: On slopes less than 20 to 25%, soil cover may be deep enough to permit excavation of fox holes. Best area is at north end around Liloan. A few sites for cave shelters can be found in hills around Liloan and locally in the mountains to the south of the town.
ation: Good views of all parts of lowlands obtained from high on Poro and Pacijan. regular topography observation on most of Ponson.	Natural Cover: No cover for large units. Ravines and ridges give good cover for personnel in hilly areas. Lowlands can be brought under fire from hills; narrow beaches exposed to fire

generally fronted by sand beaches border the
A narrow strip of lowland lies inland betwee
interior. At the northeast end it widens in
the island is occupied by a belt of hills 30
average about 400 feet. Slopes are moderate
Rivers: The Bituca River on the southeast e
known perennial river in the Camotes. Other
are dry or only flow in small trickles for a
In the wet season streams fill their channels
to ten feet.
Poro Island: Coastal Features: The south c
a broad gravel beach rising gently to the mo
interrupted at a few points by steep bluffs;
is more than 100 feet above sea level. Grav
southeast and west by belts of mangrove. El
reefs form flats terminating in coastal bluf
The crest of the hills which occupy most of
from the south coast to altitudes of more th
dissected by several very deep narrow ravine
the crest are much lower, range from 3 to 15
No perennial streams. Valleys and ravines a
Pacijan Island: Aside from a few small sect
bluffs 10 to 50 feet high; fronted by narrow
dulating land extends inland from coast. Th
soil is mostly under cultivation. Near nort
rounded by nipa swamps and mud flats. A gro
central parts of the island; restricts lowla
800 feet high; slopes gentle to moderate.

remainder of the island.
n the coast and the hilly
to small plain. Most of
0 to 700 feet in altitude;
, generally 15 to 20%.
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streams on Ponson Island
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the highest, near Poro,
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fs about 20 feet high; locally a few small areas of mangrove.
the island lies in the southern part. Hills rise abruptly
an 1,250 feet. Slopes are commonly more than 40%; are
s. On the rest of the island slopes of the ridges rising to
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sandy or gravelly beaches. A broad belt of gently un-
is lowland, formed by raised coral reef with fine silty
h end is Lake Lanao, a shallow brackish water lake sur-
up of rounded hills occupies most of the south and
nd to narrow band on southeast coast. Hills are 600 to

when wet is difficult to move over.
Existing Roads and Trails: Roads connect larger settlements on all three islands. Most of mileage surfaced and suitable for all-weather use.
Cross-Country Movement: Except for very steep high hills in south-central Poro and Pacijan, mechanized units can move over most lands. Deep ravines, steep or rocky slopes will ious obstacles to movement across the hilly area Lake Lanao and its broad border of soft muddy gr must be by-passed.
Rivers: Streams and dry ravines are obstacles t during and for some time after heavy rains.

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a/ See Vegetation Sheet.
b/ See Rivers Sheet.
c/ See Soils Sheet.
d/ See Road Maintenance and Construction Sheet.

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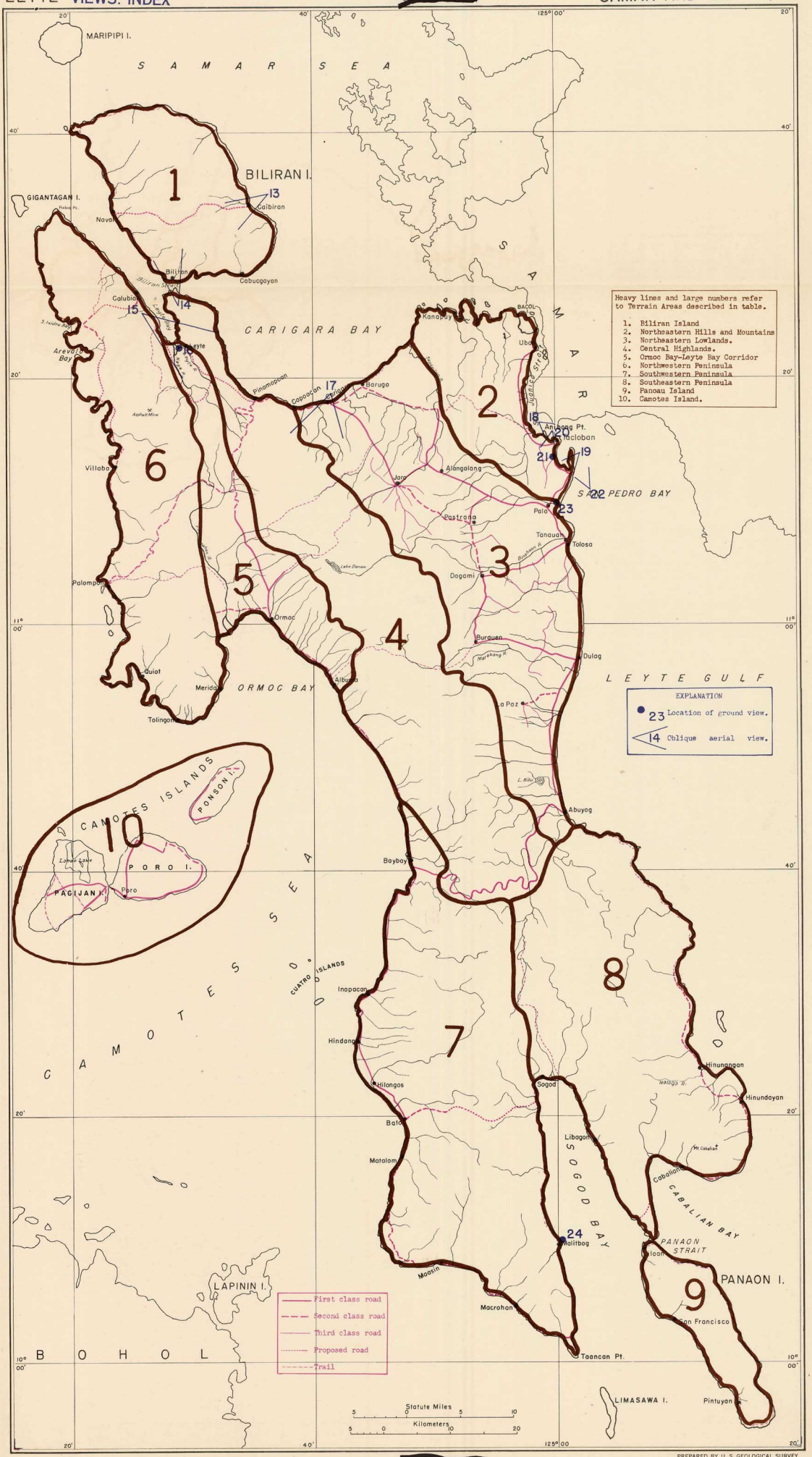
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locally be ser-
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o movement only

from the bluffs.
Artificial Cover: Shallow soil cover which overlies hard coral rock makes excavations of fox holes difficult or impossible on many parts of low areas. In some parts of hills, soil deep enough for hasty fortifications. In a few places, conditions suitable for protected shelters.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

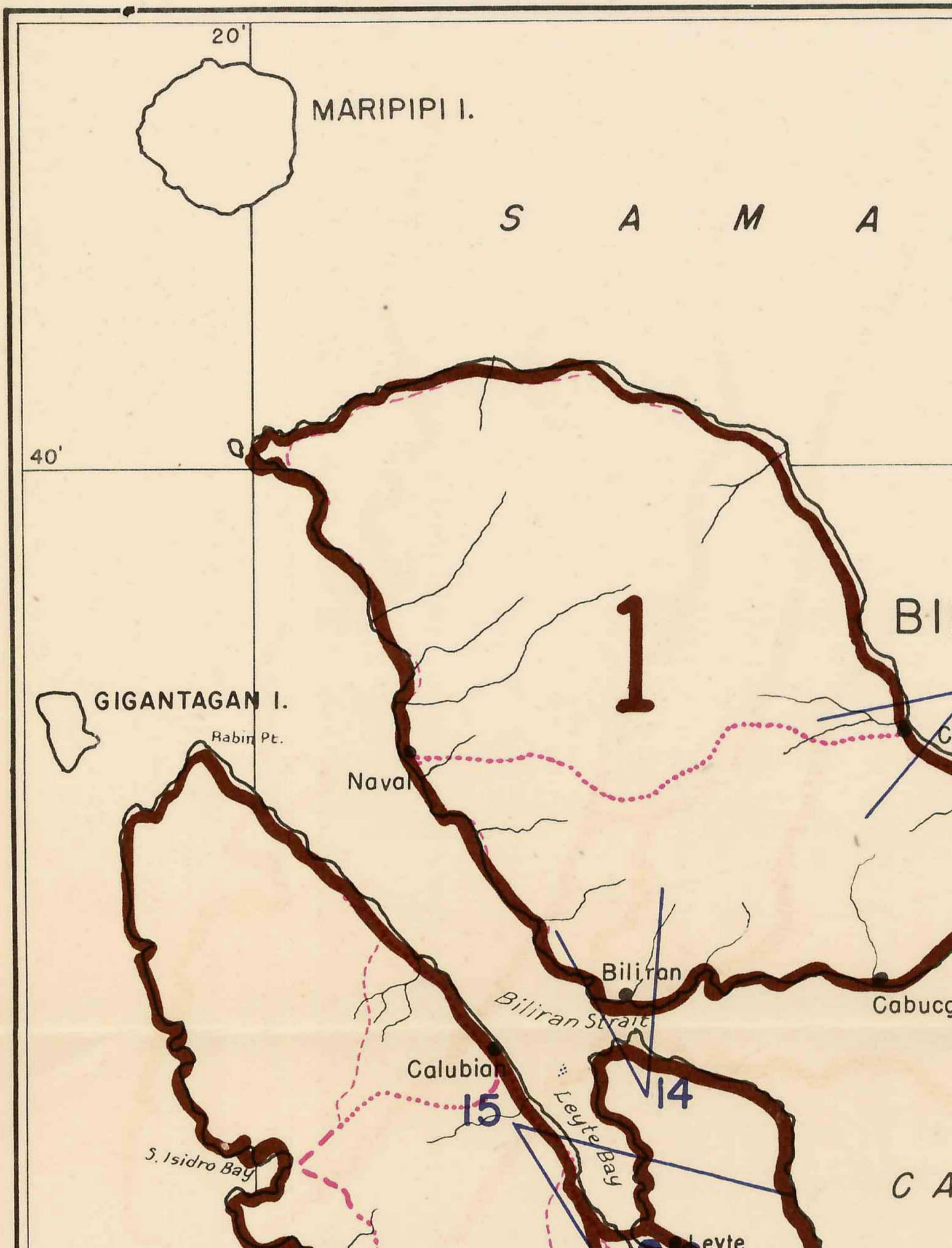
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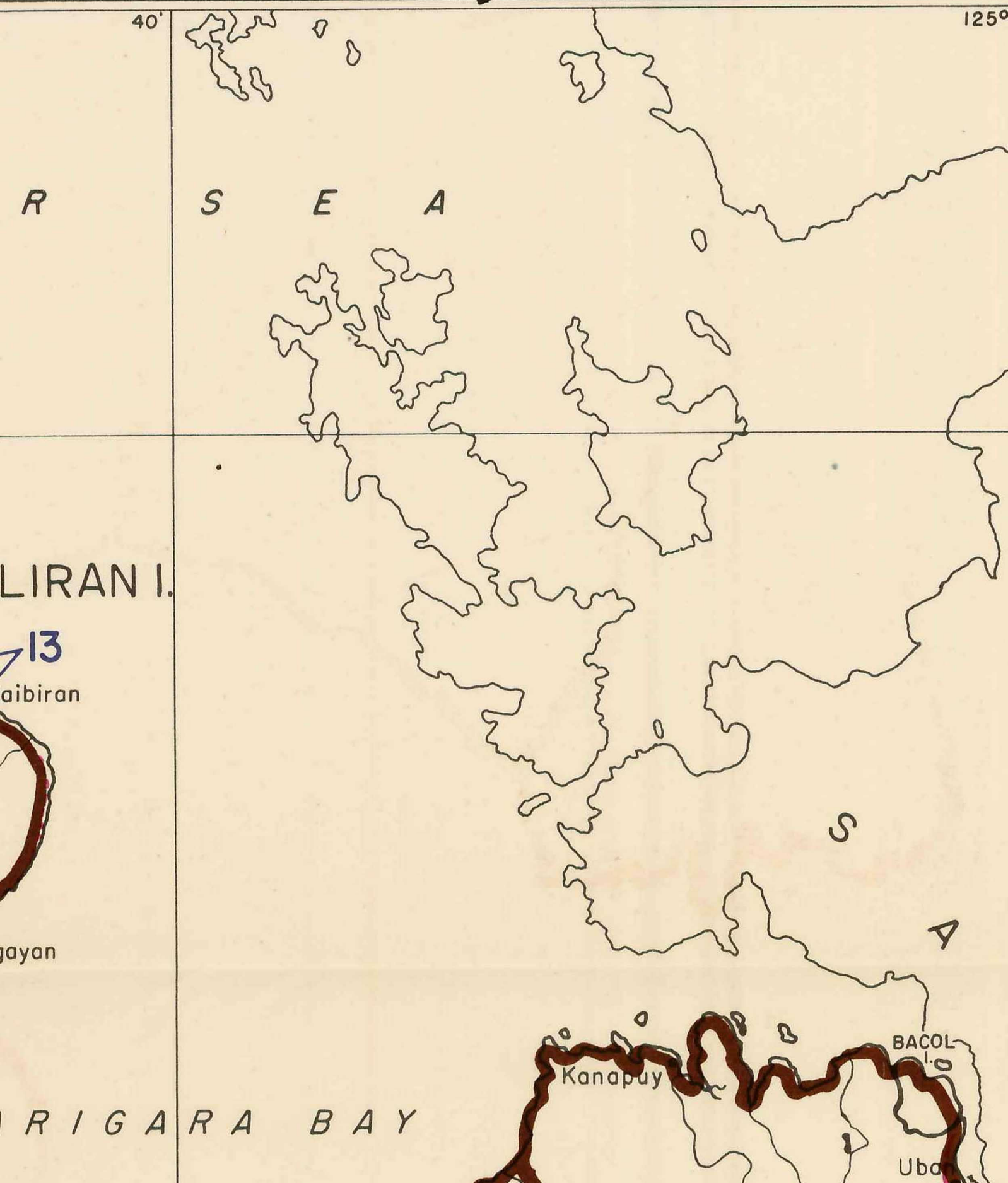
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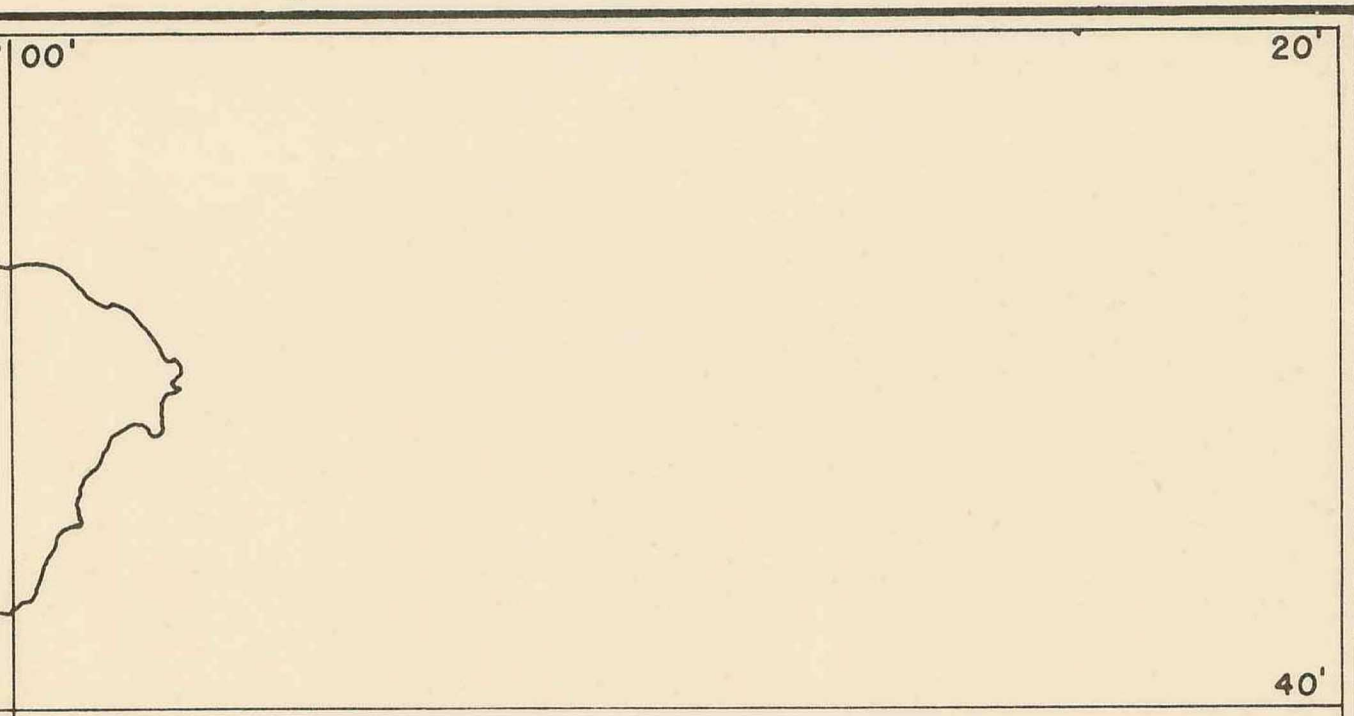
LEYTE VIEWS: INDEX



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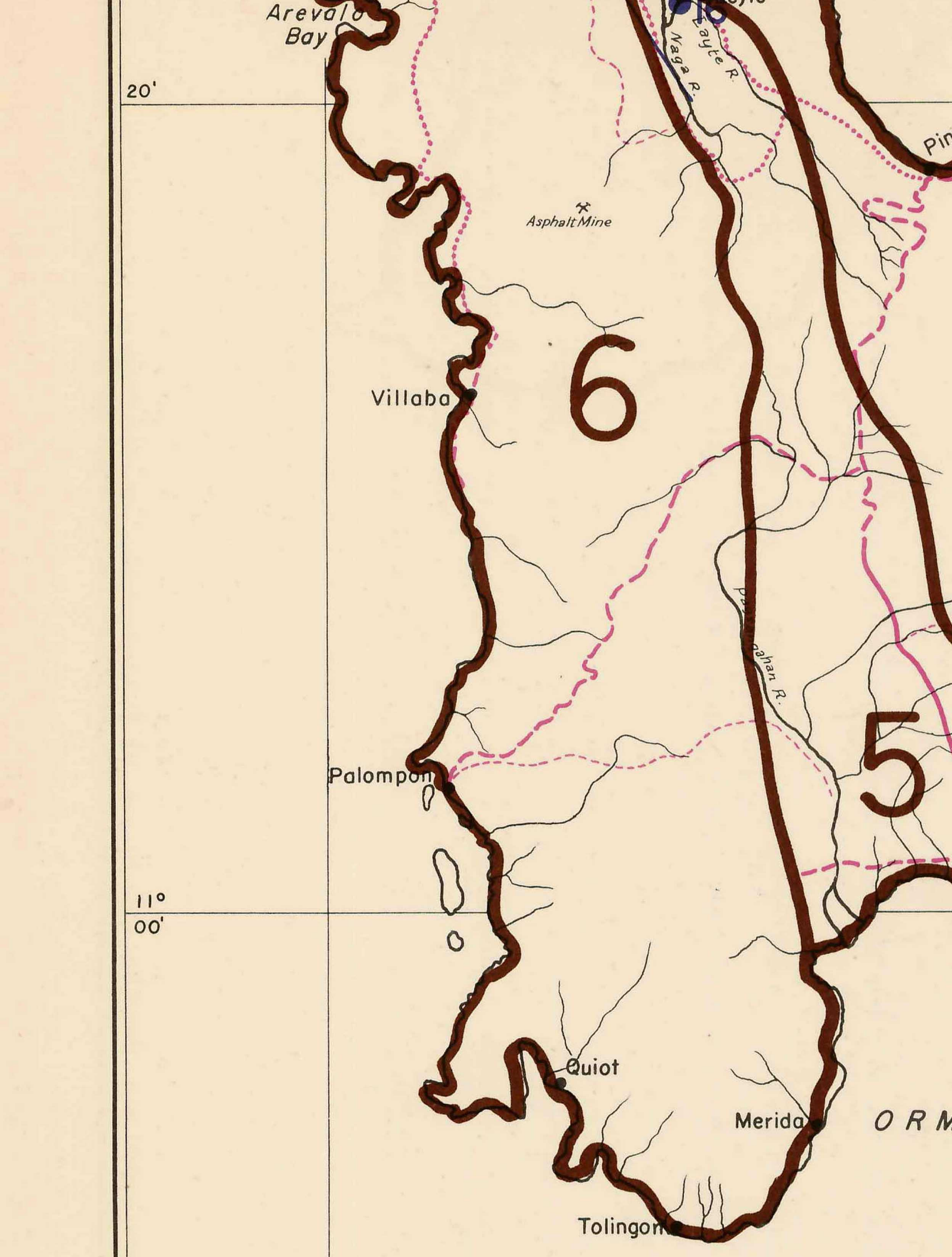


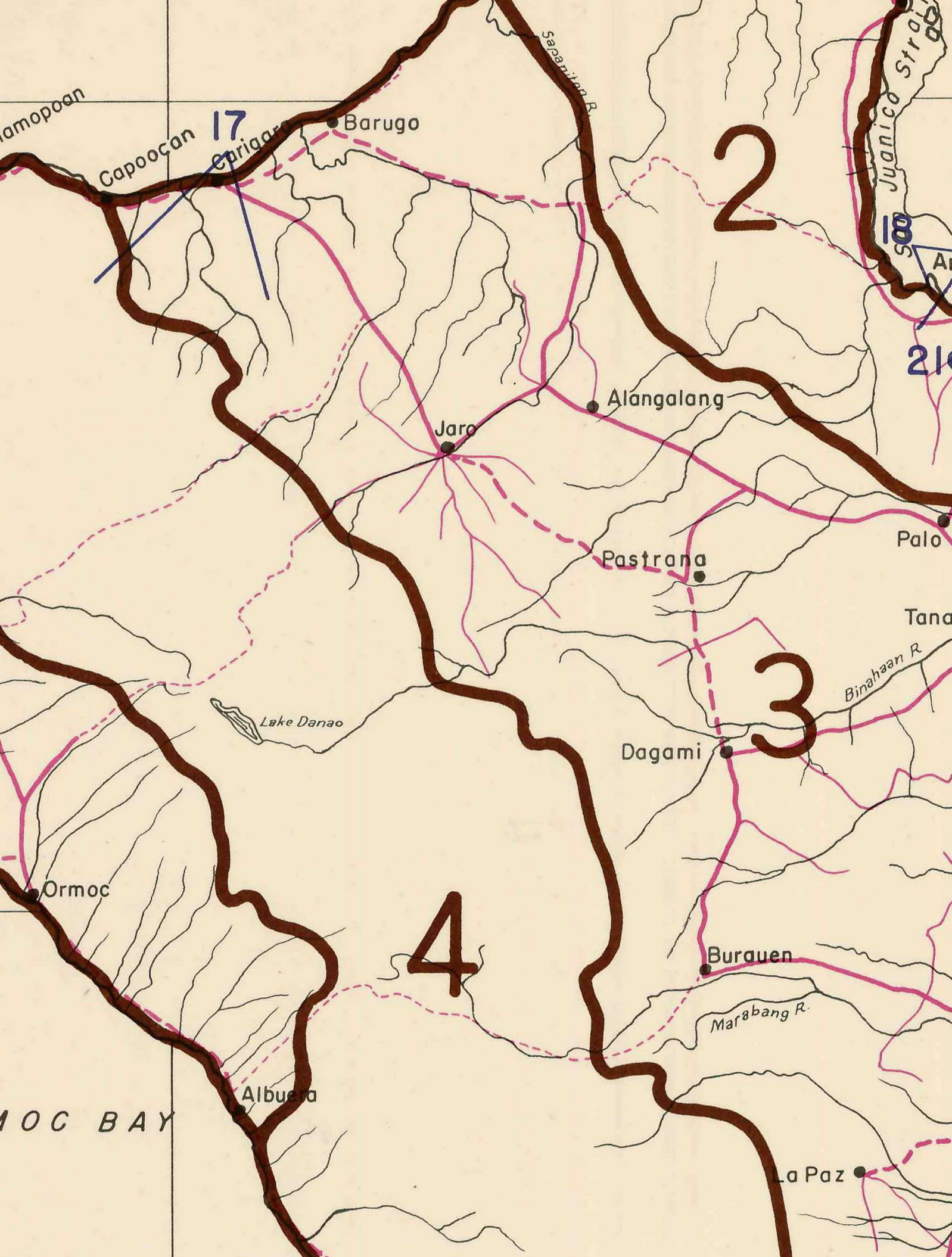
SAMAR AND LEYTE (P.I.)



Heavy lines and large numbers refer to Terrain Areas described in table.

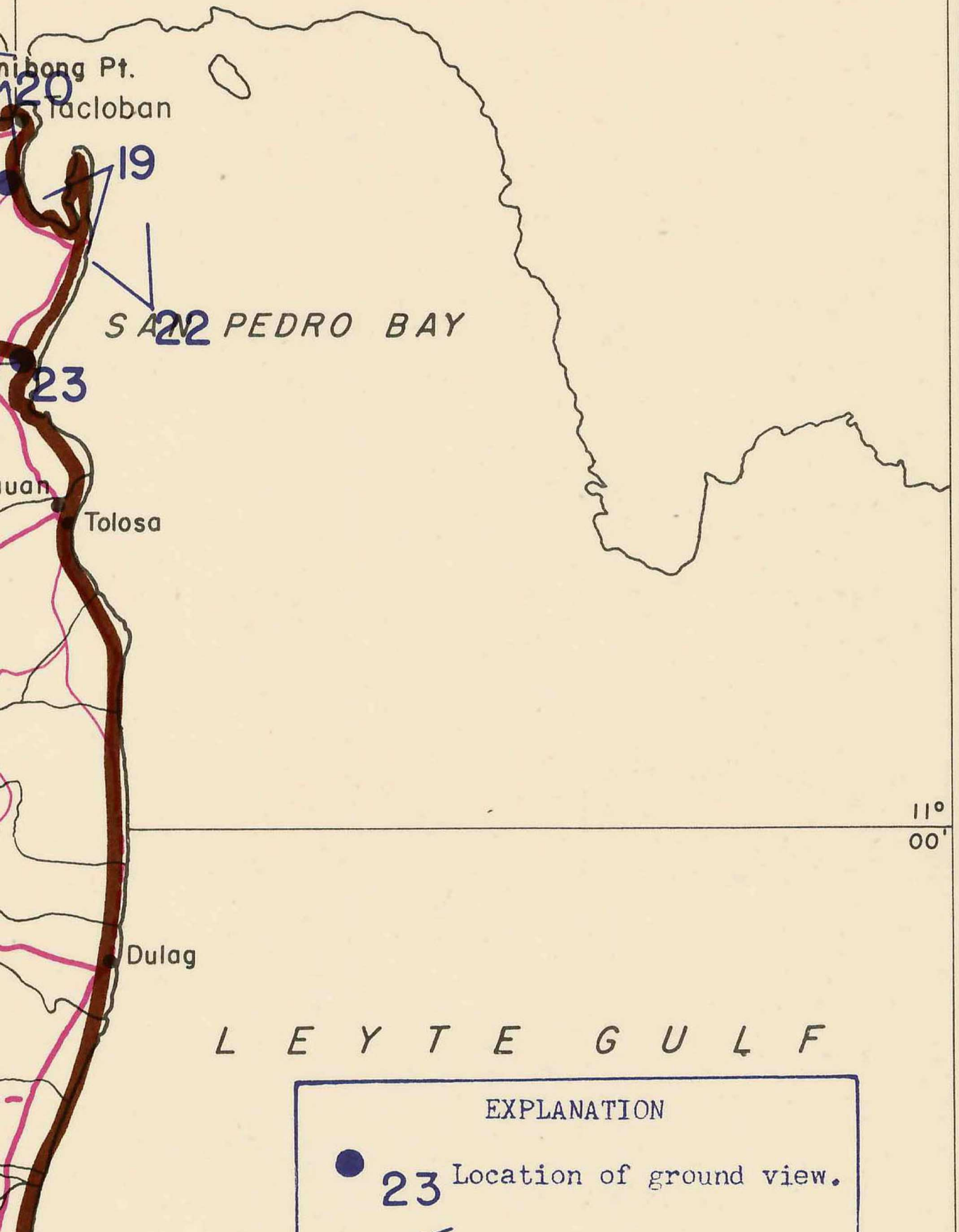
1. Biliran Island
2. Northeastern Hills and Mountains
3. Northeastern Lowlands.


Arevalo Bay
20'
Naga R.
Asphalt Mine
6
Villaba
Palompon
5
11°
00'
Quiot
Merida
Tolingon


Capoocan
17
Barugo
Sapanitan R.
2
Juanico Strait
18
Alangalang
Jaro
Palo
Pastrana
Tana
3
Binahaan R.
Lake Danao
Dagami
Ormoc
4
Burauen
Marabang R.
Albuera
La Paz
MOC BAY

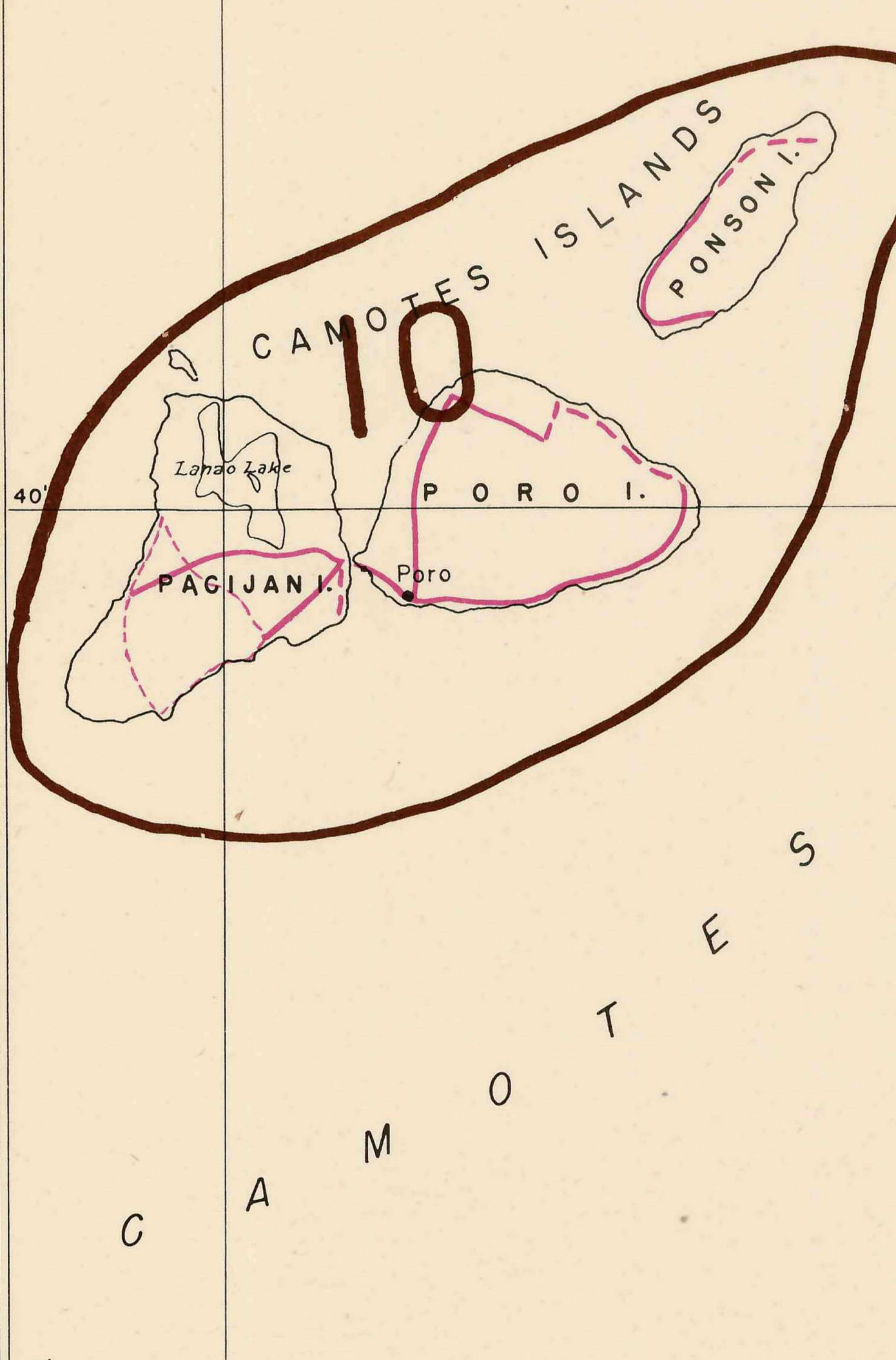
4. Central Highlands.
5. Ormoc Bay-Leyte Bay Corridor
6. Northwestern Peninsula
7. Southwestern Peninsula
8. Southeastern Peninsula
9. Panoau Island
10. Camotes Island.

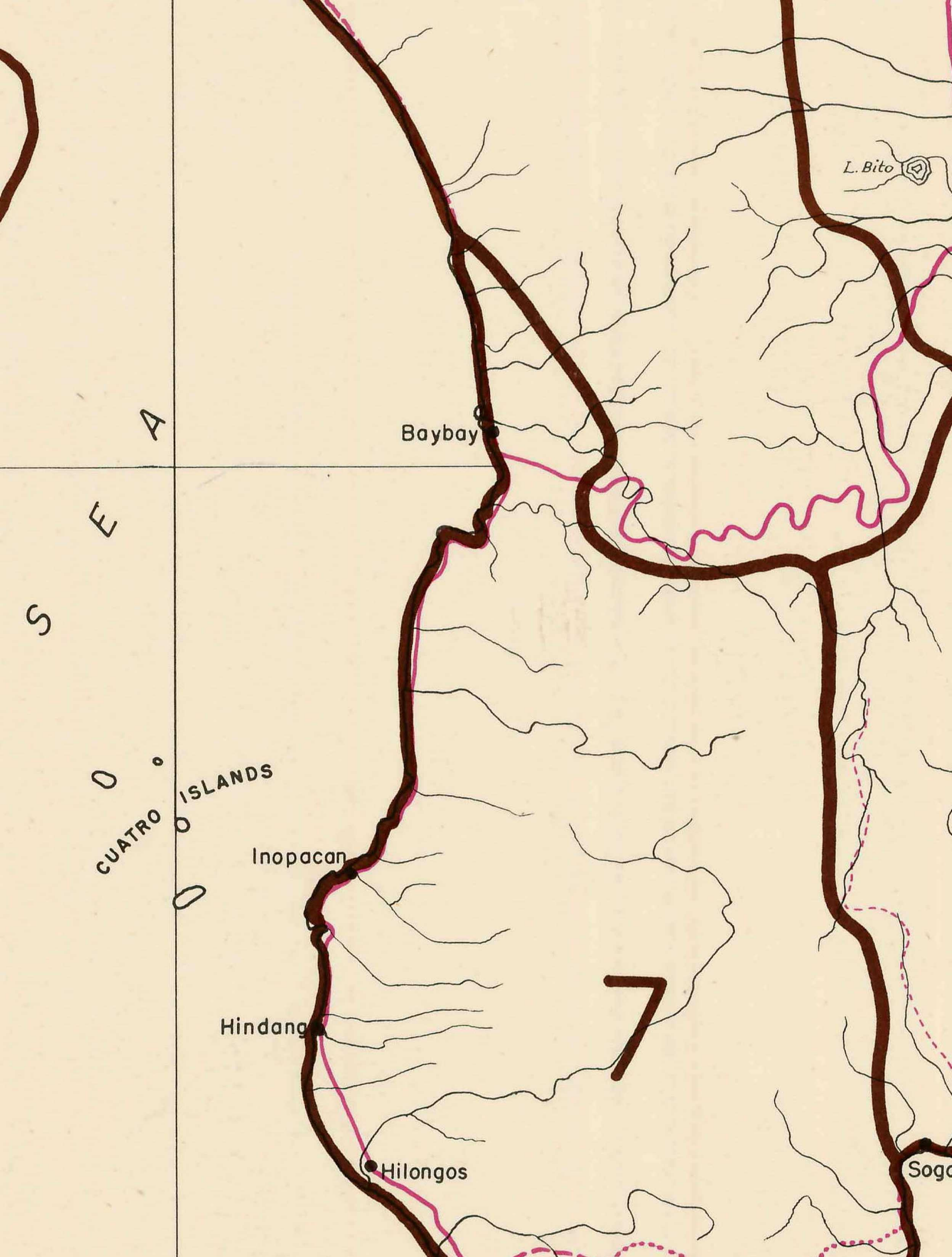
20'

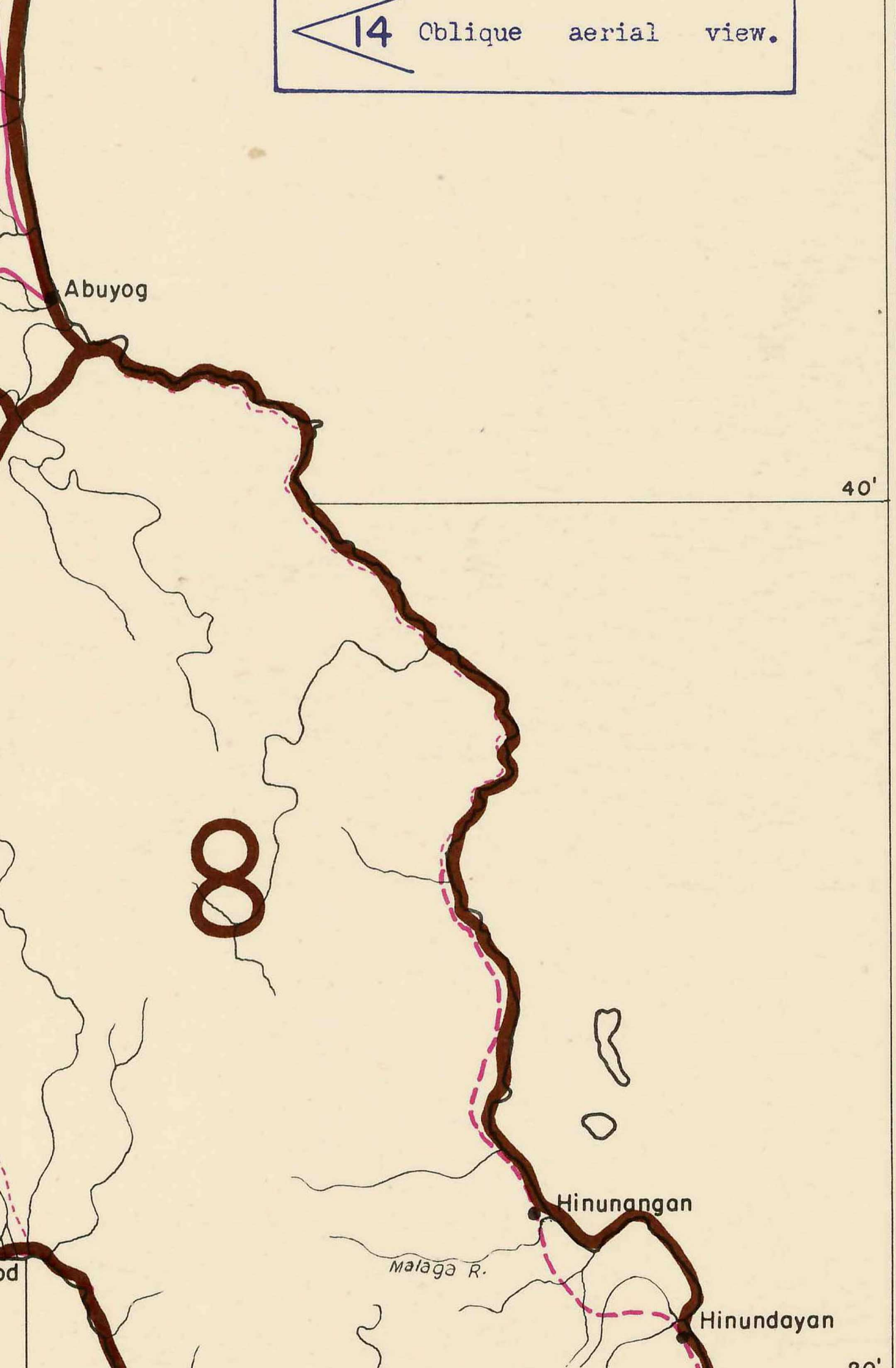


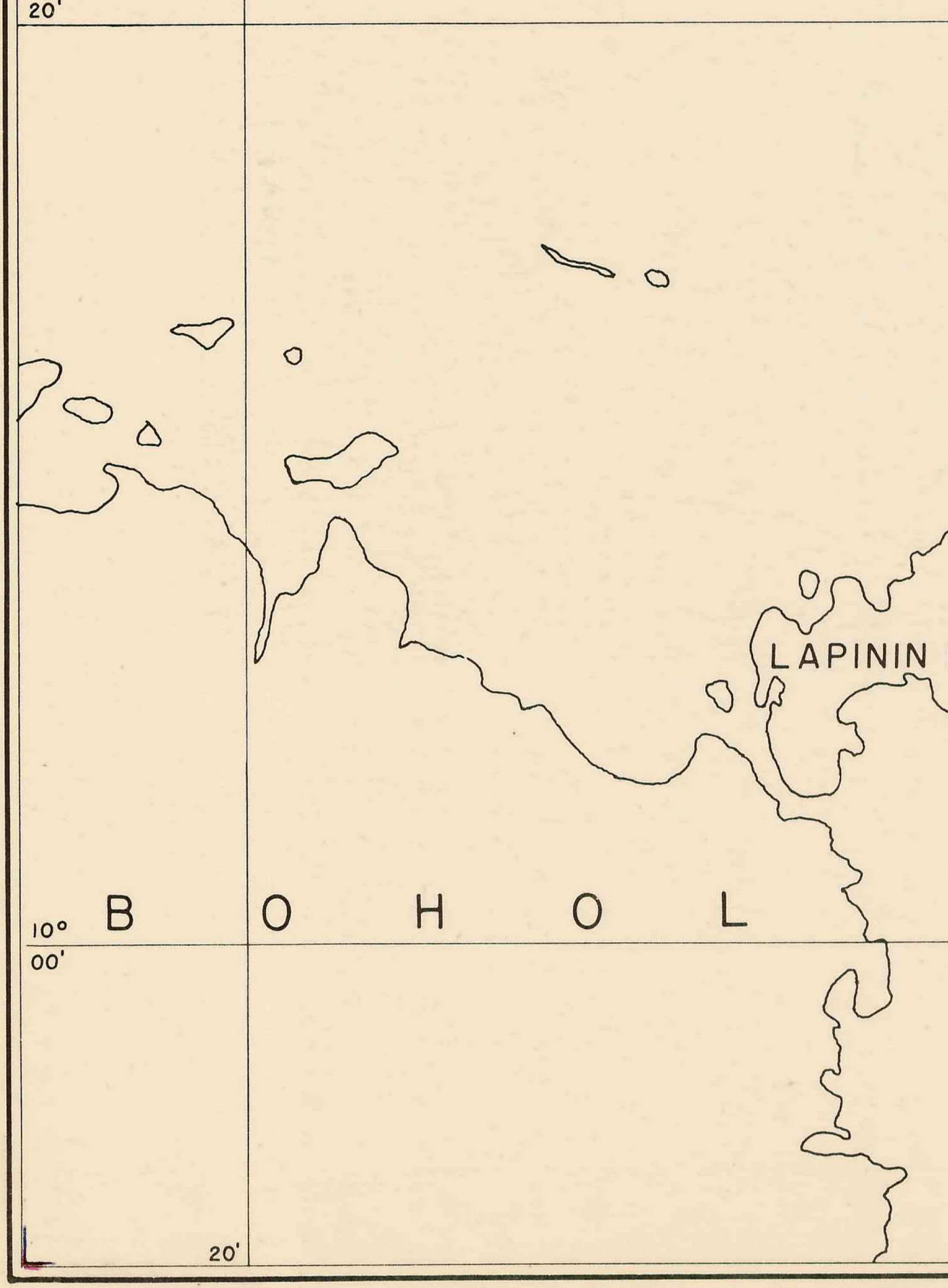
EXPLANATION

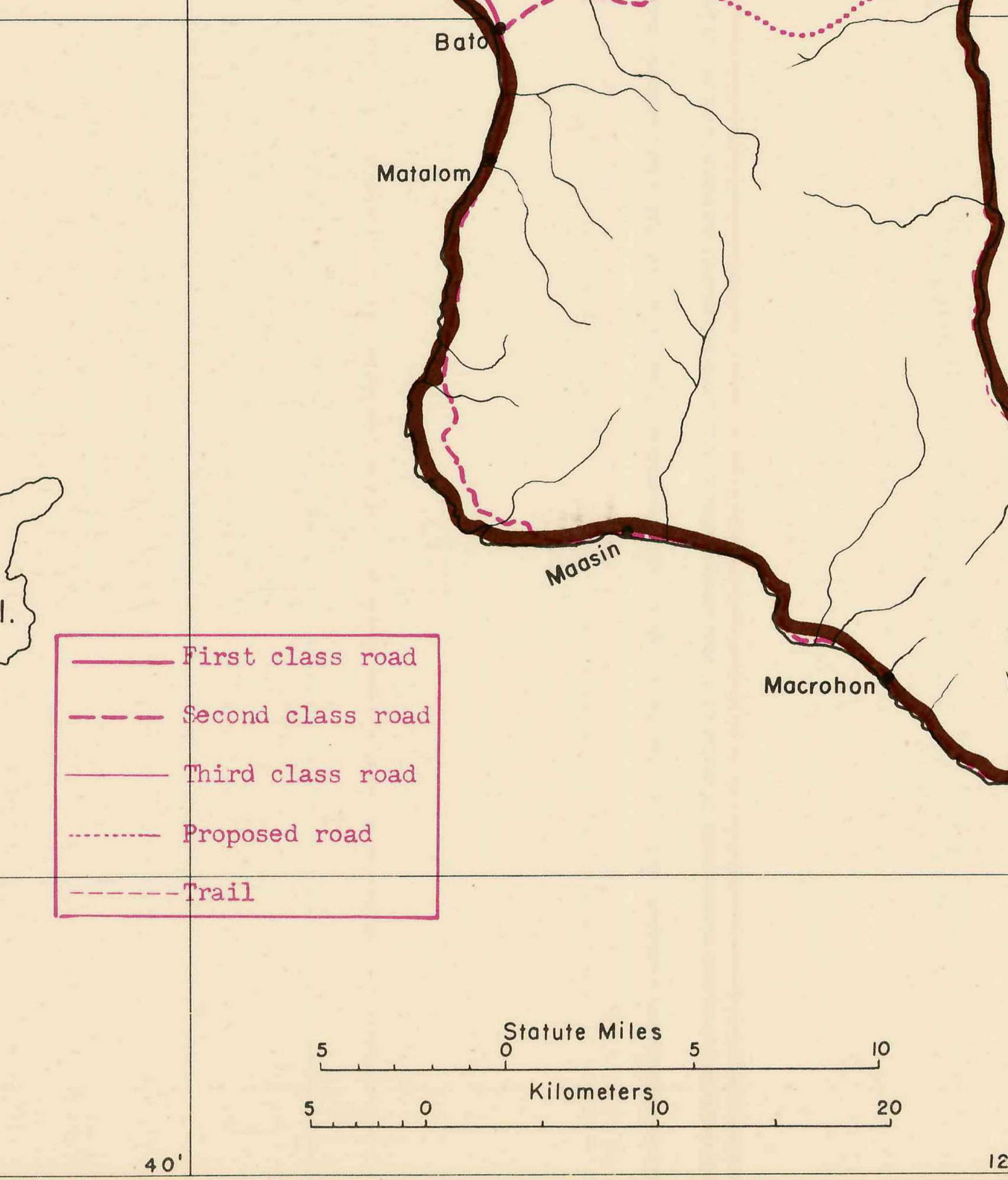
● 23 Location of ground view.


CAMOTES ISLANDS
10
PONSON I.
Lanao Lake
40'
PORO I.
PAGIJAN I.
Poro
CAMOTES

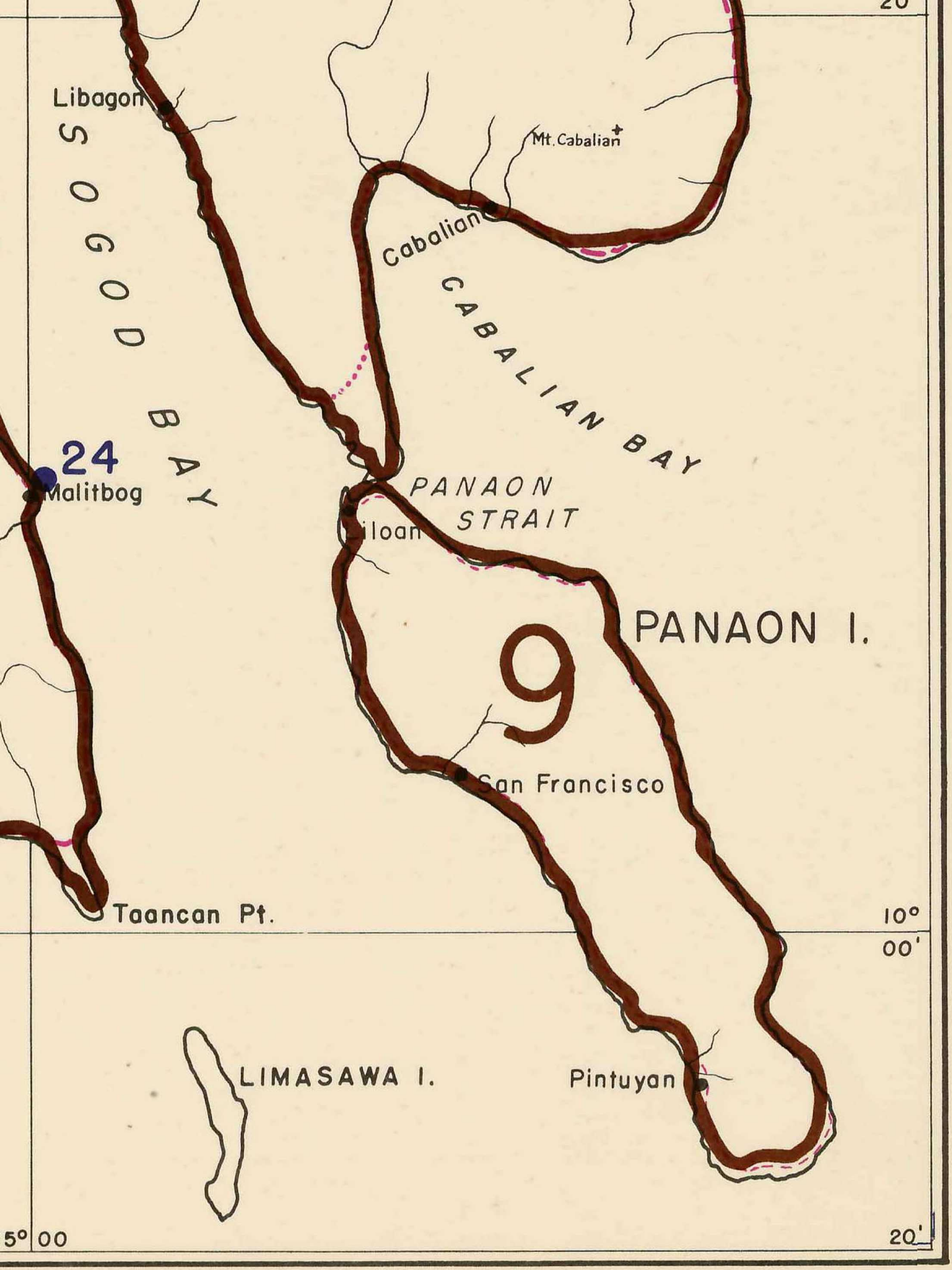

L. Bito
Baybay
S E A
CUATRO ISLANDS
Inopacan
Hindang
Hilongos
Soga
7


14 Oblique aerial view.
Abuyog
40'
8
Hinunangan
Malaga R.
Hinundayan

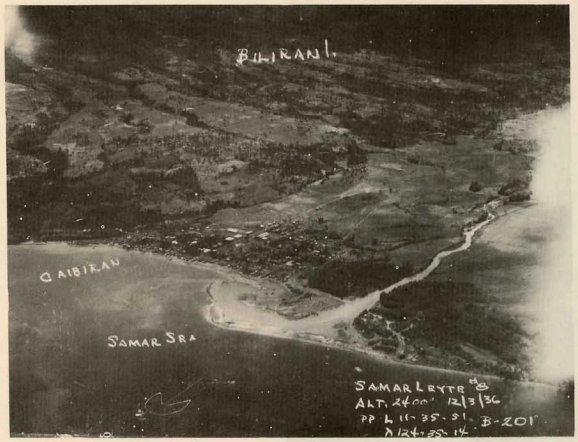

20'
LAPININ
B O H O L
10°
00'
20'



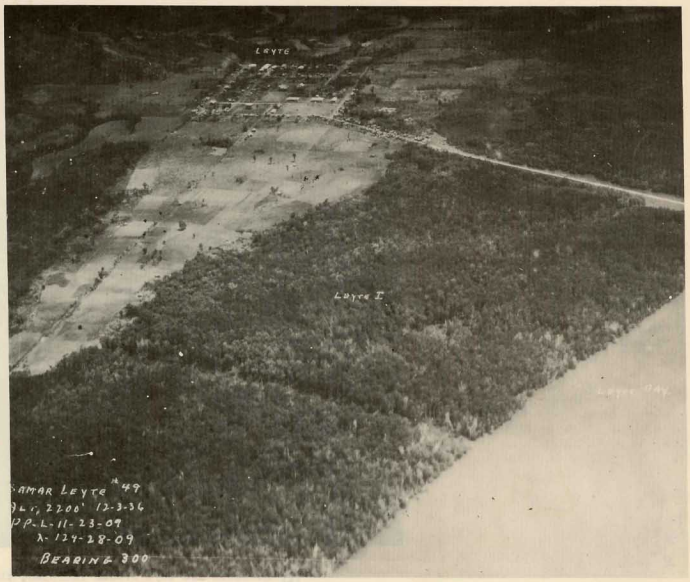
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FOR
CHIEF OF ENGINEERS, U. S. ARMY



13 The three principal lowlands on Biliran Island have low, nearly flat to gently rolling ground bordered on at least one side by higher, gently sloping plains and benchlands dissected by steep narrow ravines. Sloping plains which border the north part of the central range of Leyte (Terrain Areas 3 and 5) are similar to plain shown above, but generally broader and more deeply dissected. (ONI 61970)



16 Broad coastal belt of mangrove swamp backed by slightly higher, better-drained coastal plain (left middle and center background); mangrove is typical for river mouths of larger coastal lowlands on both Samar and Leyte. Plains are commonly cultivated to corn or other small crops; in some areas rice is main crop. (ONI 62423)



14 Vegetation pattern in foreground typical of many hill lands in northern Leyte. Low rounded hills in background (altitudes 200 to 600 feet) are characteristic only of the southern end of Biliran Island; remainder of island has high rugged peaks with altitudes of 2,000 to over 4,000 feet. (ONI 61980)



15 Flood plain of Palapay (Naga) river at head of Leyte Bay, with wide band of mangrove swamp bordering the coast and extending along the river to the southern margin of the lowland (Terrain Area 5). Plain typical of most coastal lowlands bordered by low hills covered with grass, brush, or clumps of trees. Lower slopes near village in left foreground are cultivated to corn, abaca, and probably some coconuts. (ONI 62422)



17 Northwestern corner of the nearly flat plain which occupies most of the northeast side of Leyte (Area 3). The area behind the town is largely covered by rice paddies. The soft wet ground and low dikes around the paddies are obstacles to rapid movement of mechanized units on several parts of the lowlands. In the background, the high central range (Area 4) rises behind low hills and sloping benchlands which border the flat plains. Steep, much dissected, forested slopes are characteristic of most of the mountainous areas of Leyte and Biliran (Terrain Areas 1, 4, 7, 8 and 9). (ONI Samar-Leyte #41)

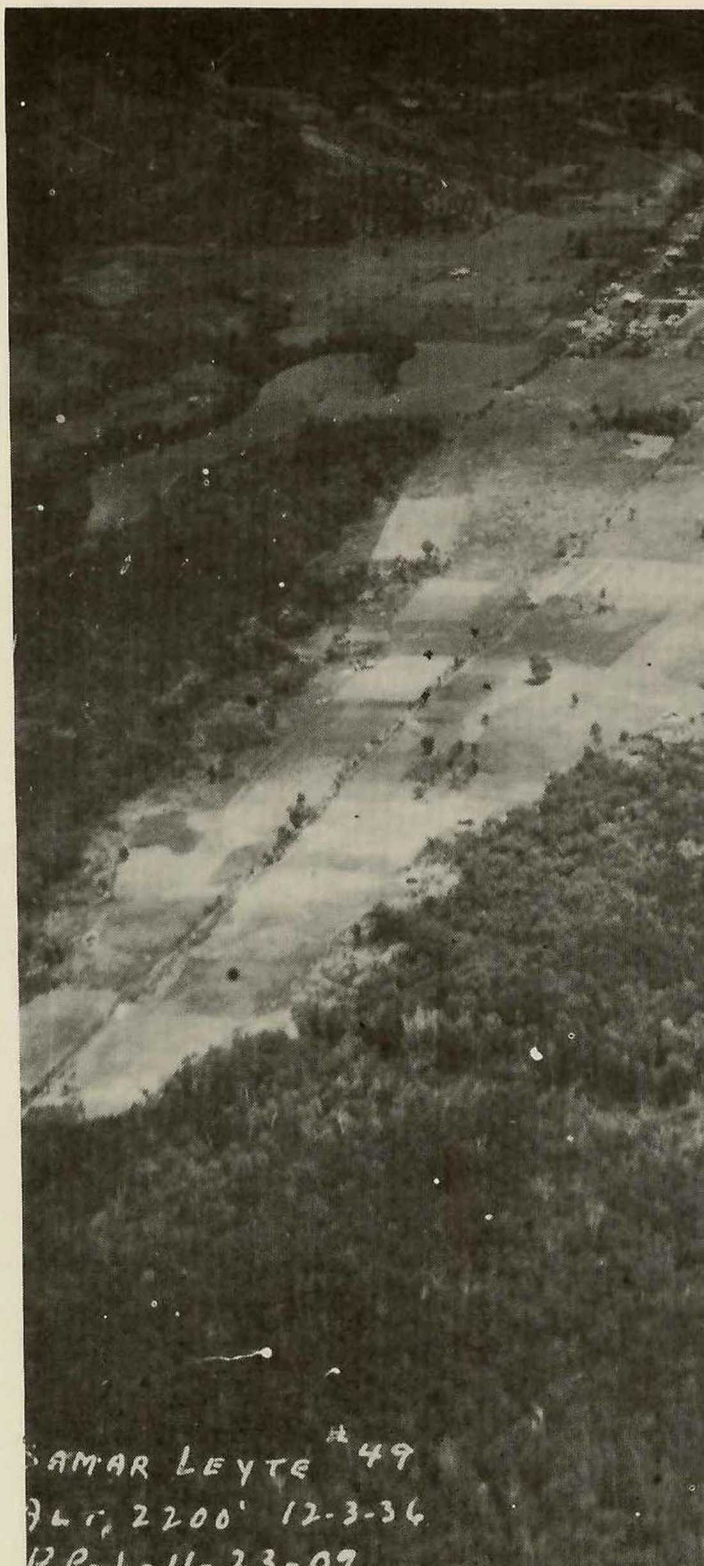
PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
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SAMAR AND LEYTE (P.I.)



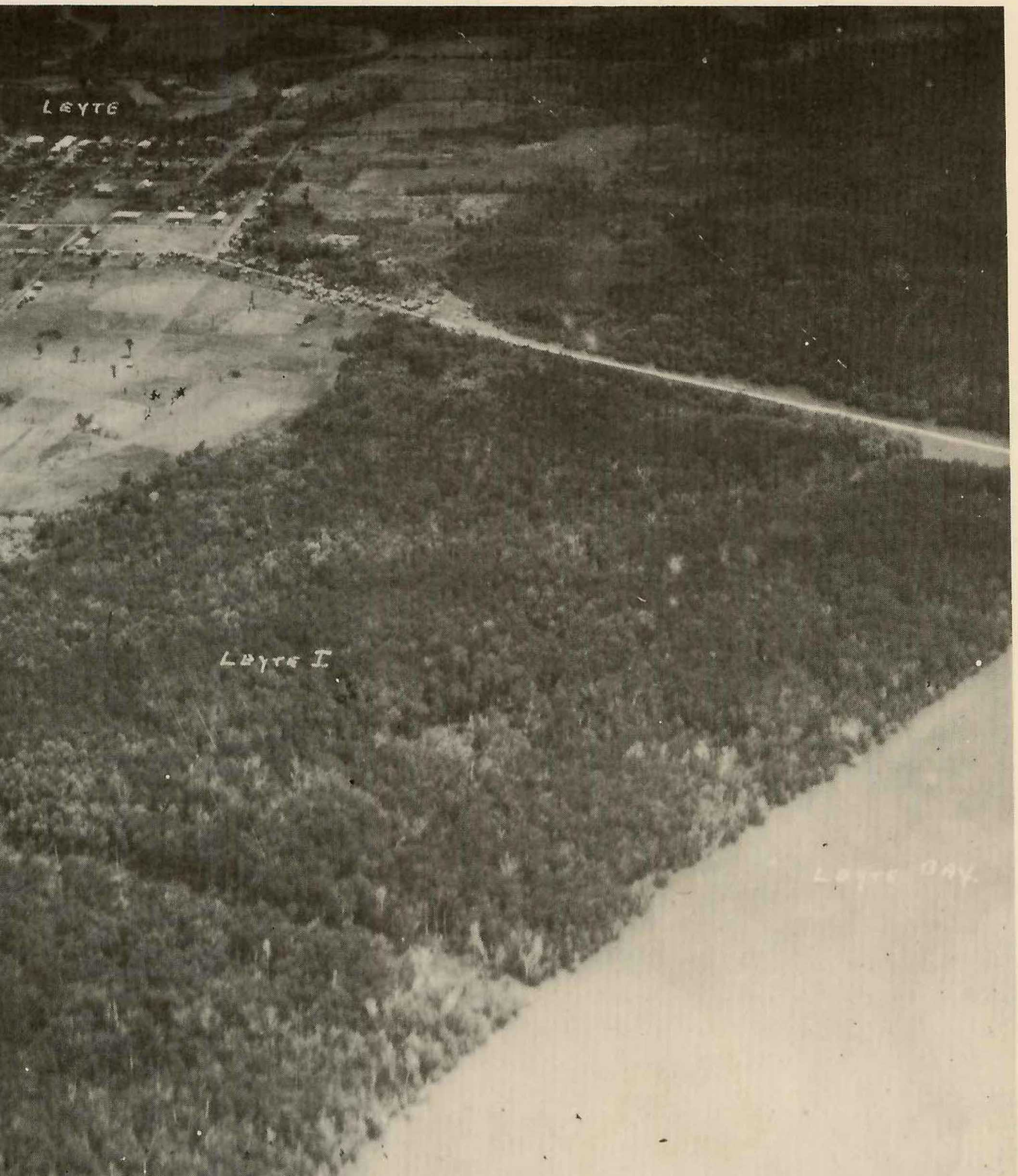
13 The three principal lowlands on Biliran
to gently rolling ground bordered on at
gently sloping plains and benchlands dis
Sloping plains which border the north part of





Island have low, nearly flat
least one side by higher,
ssected by steep narrow ravines.
the central range of Leyte

LEYTE VIEWS 13-17



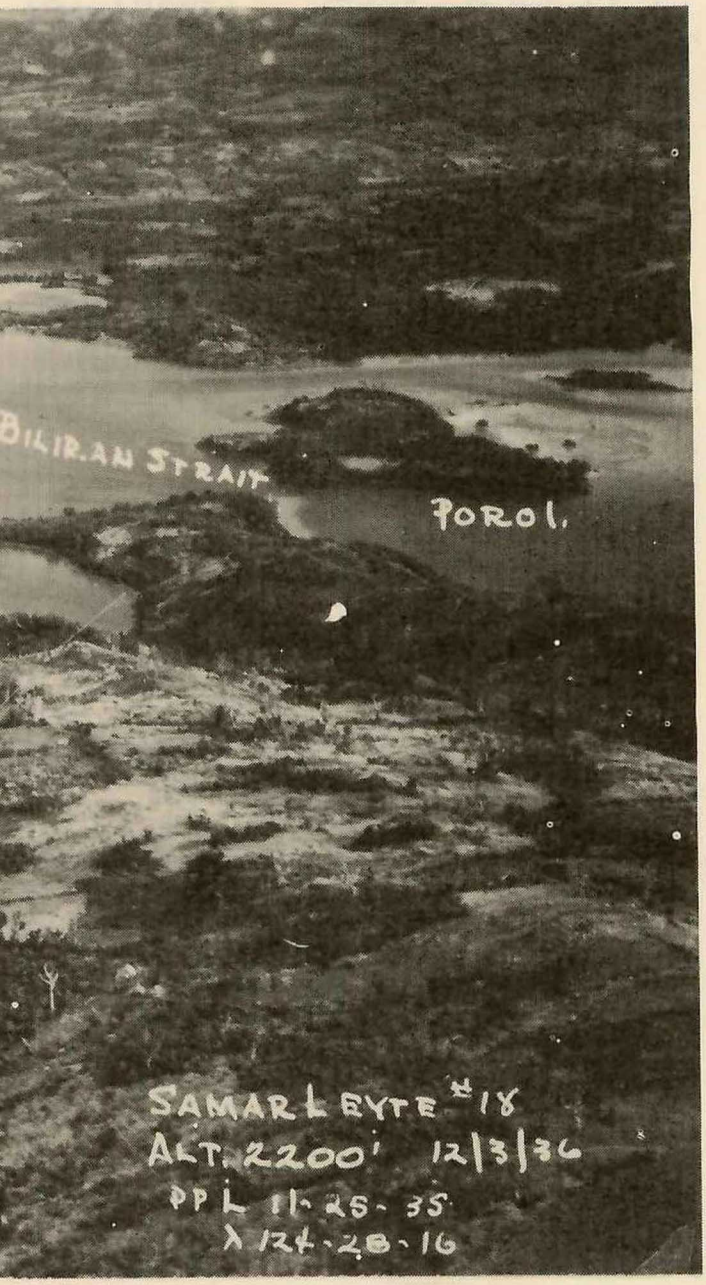
(Terrain Areas 3 and 5) are similar to plain s
broader and more deeply dissected. (ONI 6197C



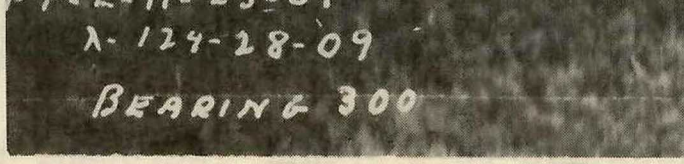
14 Vegetation pattern in foreground typica
Leyte. Low rounded hills in background
are characteristic only of the southern
of island has high rugged peaks with altitude
(ONI 61980)



shown above, but generally
)



al of many hill lands in northern
l (altitudes 200 to 600 feet)
n end of Biliran Island; remainder
es of 2,000 to over 4,000 feet.



16 Broad coastal belt c
coastal plain (left
river mouths of larg
commonly cultivated to cor
(ONI 62423)







of mangrove swamp backed by slightly higher, better-drained
middle and center background); mangrove is typical for
ger coastal lowlands on both Samar and Leyte. Plains are
rn or other small crops; in some areas rice is main crop.





15 Flood plain of Palapay (Naga) river band of mangrove swamp bordering th river to the southern margin of the typical of most coastal lowlands bordered brush, or clumps of trees. Lower slopes are cultivated to corn, abaca, and probab



at head of Leyte Bay, with wide
e coast and extending along the
lowland (Terrain Area 5). Plain
by low hills covered with grass,
near village in left foreground
ly some coconuts. (ONI 62422)



17 Northwestern c
the northeast
largely cover
around the paddies
several parts of th
(Area 4) rises behi
plains. Steep, much
of the mountainous
8 and 9). (ONI Sam

[redacted]
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corner of the nearly flat plain which occupies most of
side of Leyte (Area 3). The area behind the town is
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are obstacles to rapid movement of mechanized units on
e lowlands. In the background, the high central range
nd low hills and sloping benchlands which border the flat
n dissected, forested slopes are characteristic of most
areas of Leyte and Biliran (Terrain Areas 1, 4, 7,
ar-Leyte #41)



18 Lowlands and bays around Tacloban, the largest town on Leyte. Coconut-covered lowlands and the higher cultivated plains (right foreground) in general permit easy movement of mechanized units. Good positions commanding the town and its harbor can be obtained on low grass-covered hills to right of Tacloban. (23374 AC)



19 Lowland south and southeast of Tacloban (Terrain Area 2) is largely covered by open groves of coconuts growing on sandy soil. Although lowland is only slightly irregular, there are numerous low spots where standing water accumulates and coconuts will not grow. Low isolated hills rising sharply from plain (center middleground) are typical of the junctions of the northeastern mountains (Terrain Area 2) with the extensive lowlands of Terrain Area 3. (21210 AC)



20 The sharp angles at which cultivated plains meet forested mountains is characteristic of most of the northeast corner of Leyte (Terrain Area 2). Crescentic ridges in left background are produced by sandy ridges alternating with slightly lower belts of poorly drained ground. Road in foreground crosses coastal lowlands to village of Uban near the extreme northeast tip of Leyte where the latter is connected by ferry to Samar. (ONI Samar-Leyte 32)

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LEYTE VIEWS 18-20



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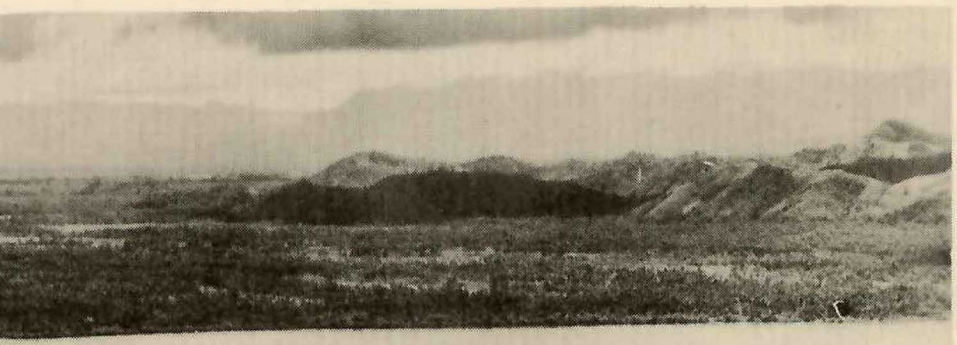
SAMAR AND LEYTE (P.I.)



harbo



Lowlands and bays around Tacloban, the largest town on Leyte. Coconut-c
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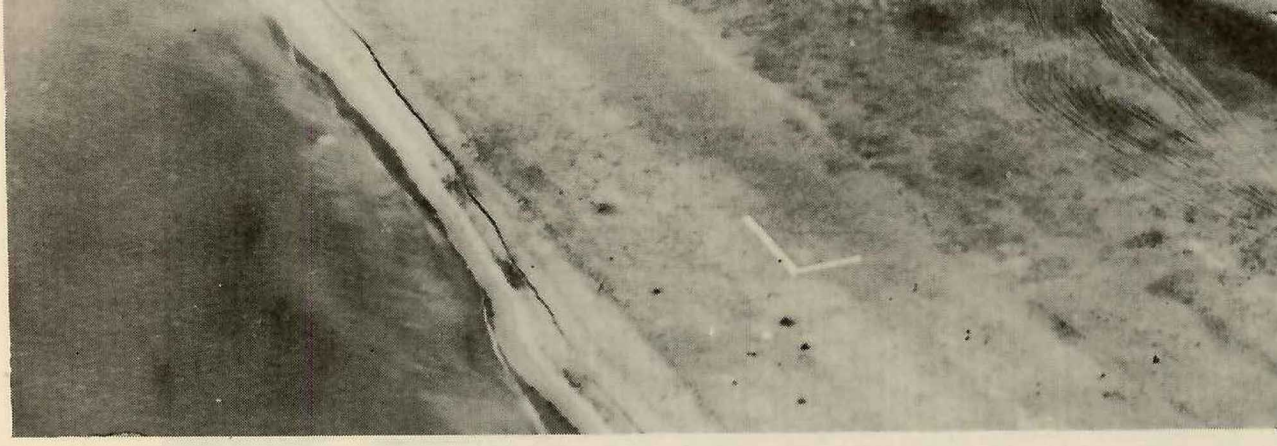




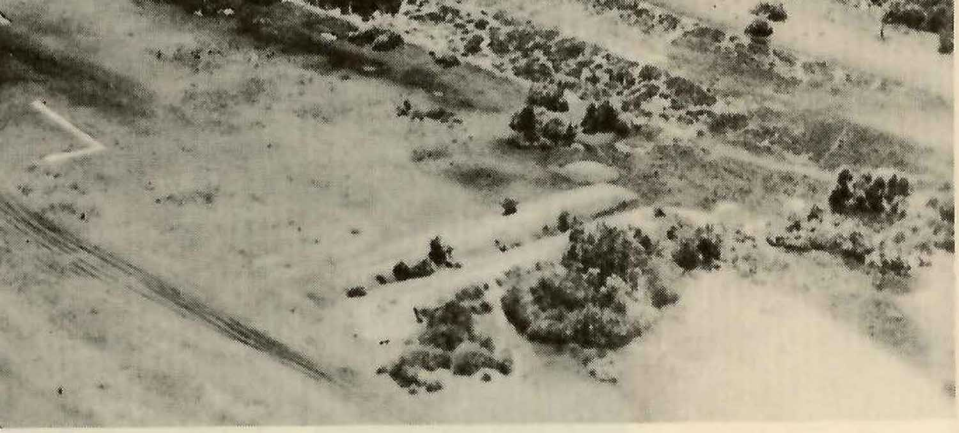


overed
permit
nd its
4 AC)





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accumulates and coconuts will not grow. Low isola
plain (center middleground) are typical of the jun
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soil. Although lowland is only
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ands of Terrain Area 3. (21210 AC)



20 The sharp angles
characteristic o
Crescentic ridge
alternating with sligh
ground crosses coastal
tip of Leyte where the
32)



at which cultivated plains meet forested mountains is
f most of the northeast corner of Leyte (Terrain Area 2).
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latter is connected by ferry to Samar. (ONI Samar-Leyte

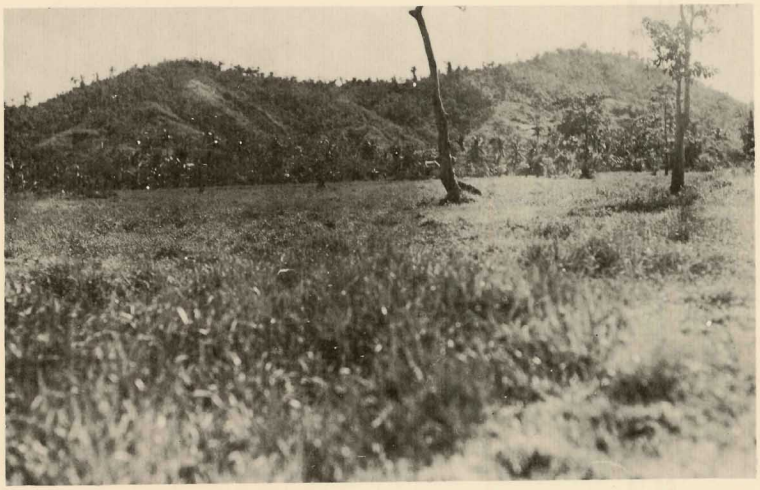
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21 Lowland areas of very sandy soil, as well as sand beach ridges, are generally covered with open stands of coconut palms. Undergrowth largely low grass and small bushes. (ONI 315-005)



22 San Juanico Strait, separating Samar and Leyte, is everywhere very narrow and tortuous. The channel can be easily commanded from positions on the high hills of northeast Leyte (left background) and from a few high points on Samar, such as Mt. Danglay. (ONI 29871)



23 Flat open plains of Terrain Area 3 meet the low steep-sided hills on east and northeast side at relatively sharp angle. Low open vegetation permits excellent observation from many parts of the hills. (ONI 315-018)



24 Coarse pebble or cobblestone beaches are typical of the coast on many parts of southern Leyte where high steep mountains are separated from the sea by only a narrow strip of lowlands (generally less than a half mile wide). (OSS 96239)

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SAMAR AND LEYTE(P.I.)



21 Lowland areas of very sandy soil

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LEYTE VIEWS 21-24



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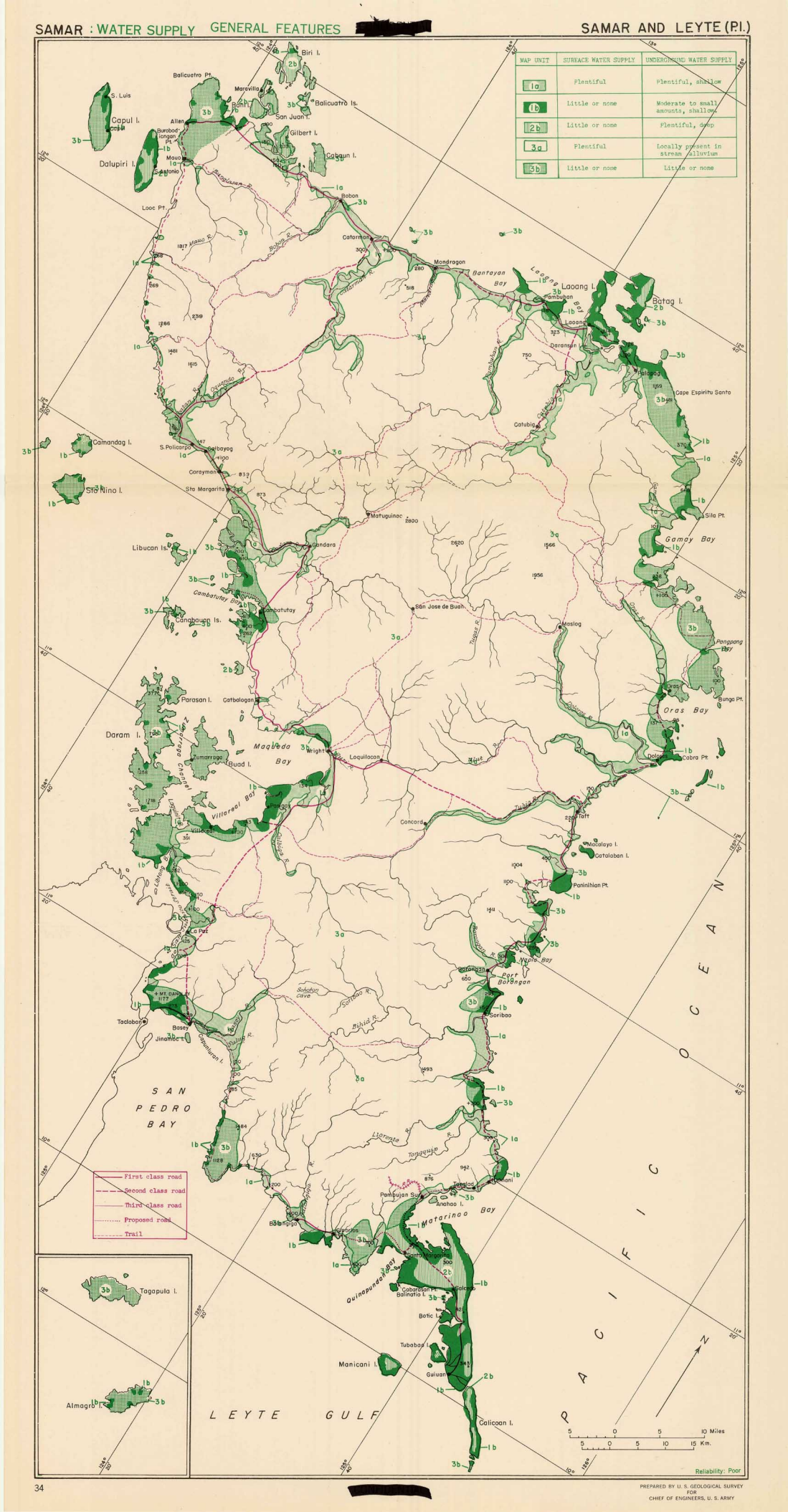


he coast on many parts
rated from the sea by
a half mile wide).

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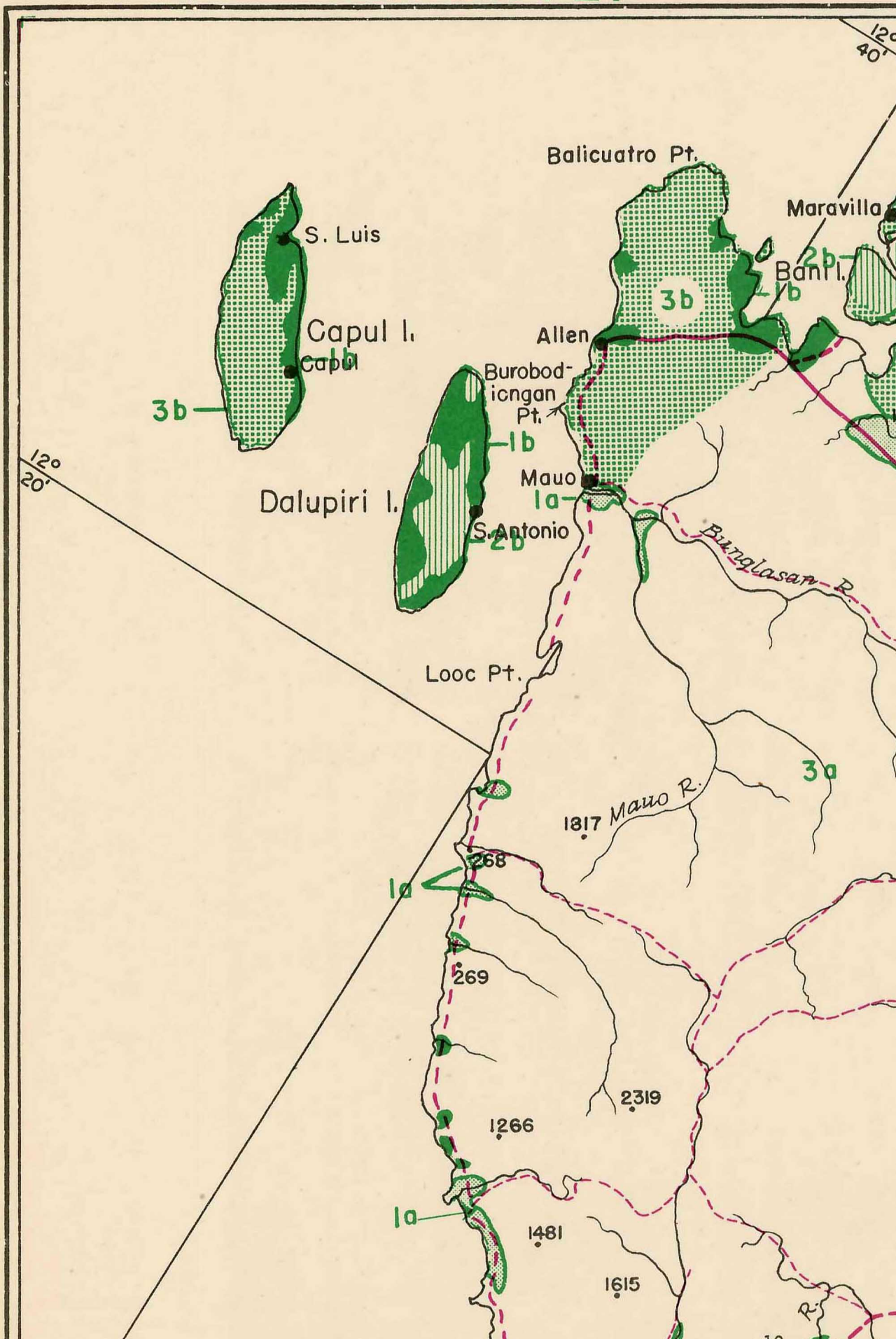
SAMAR : WATER SUPPLY GENERAL FEATURES

SAMAR AND LEYTE (P.I.)

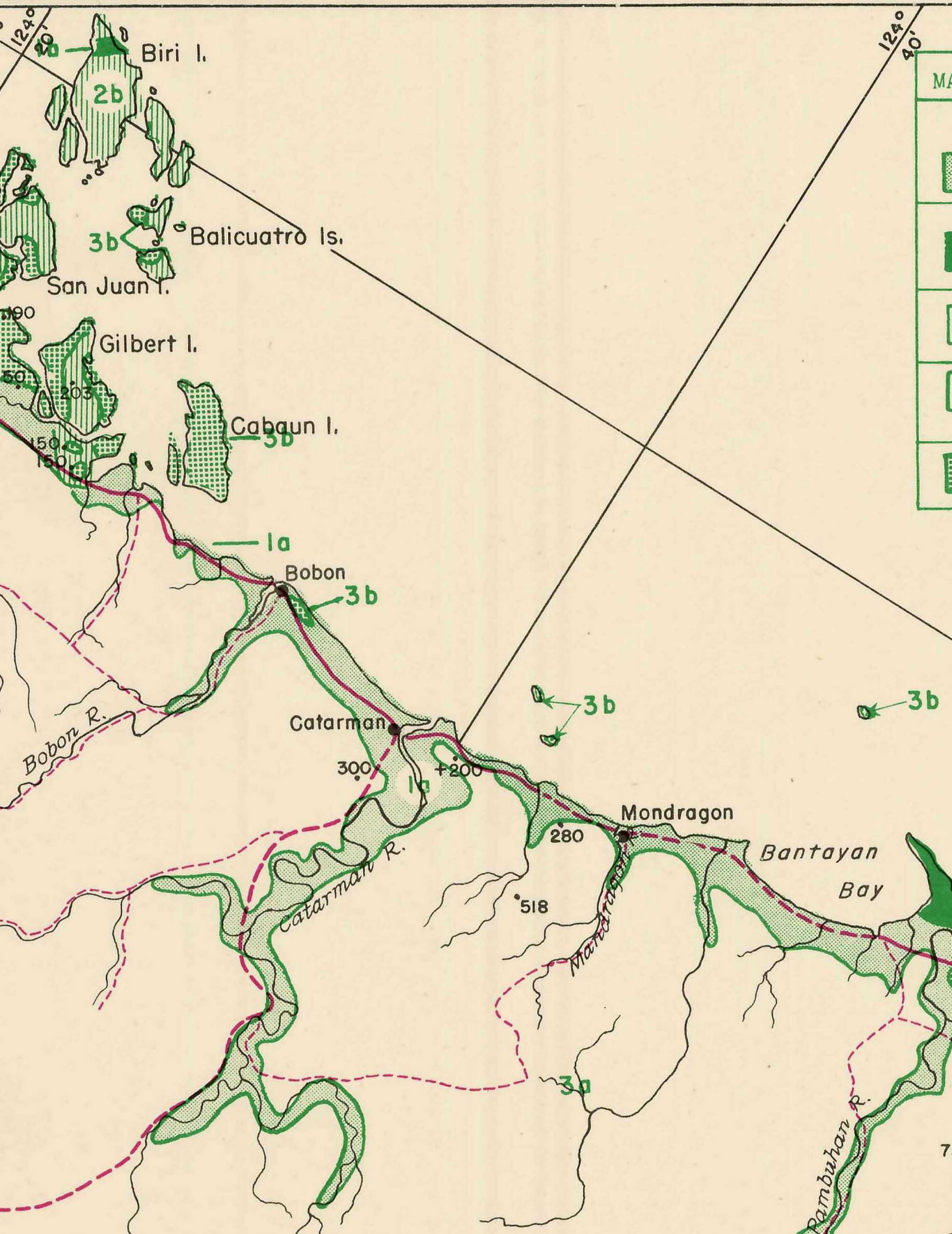


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SAMAR : WATER SUPPLY GENERAL

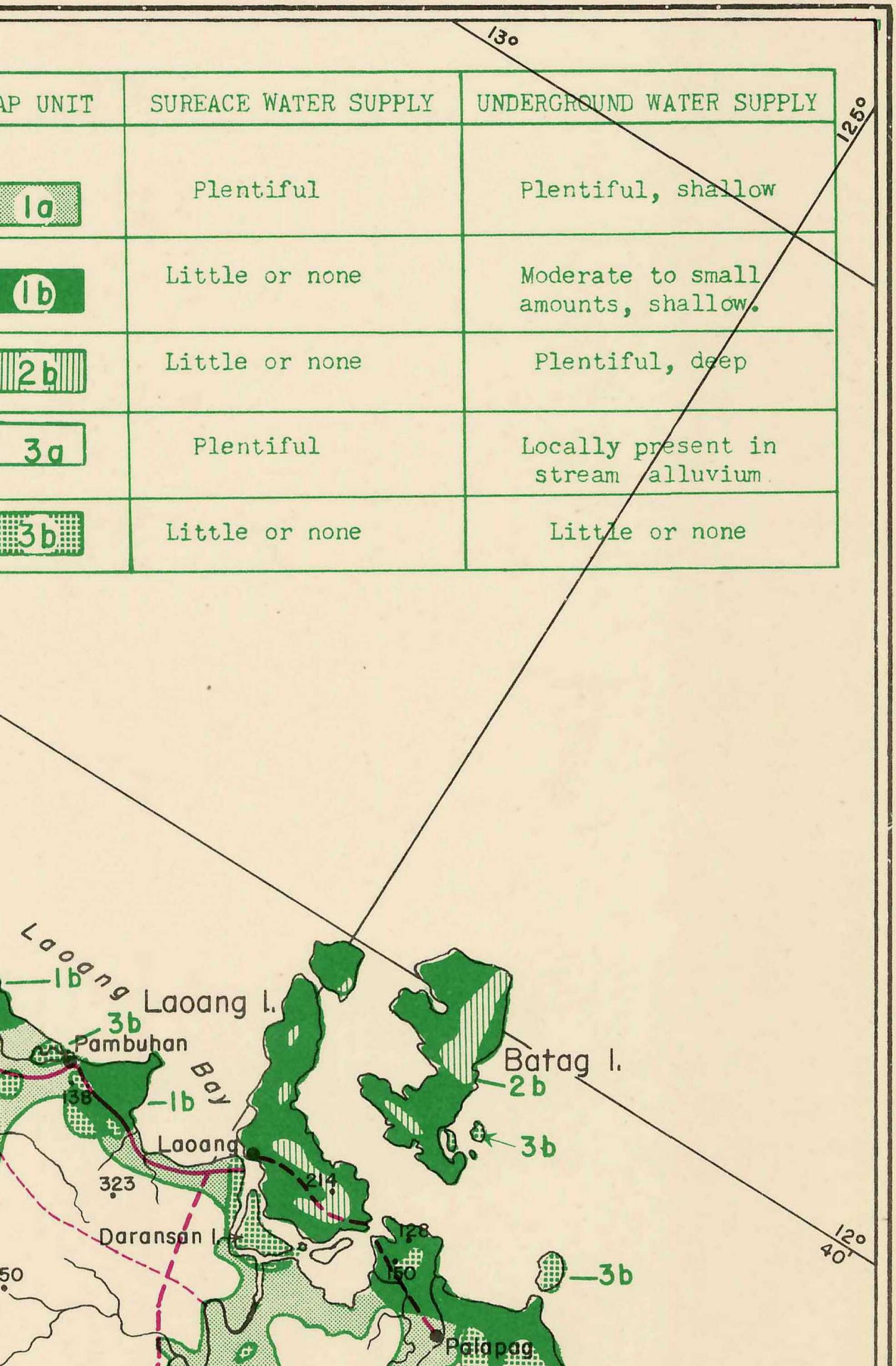


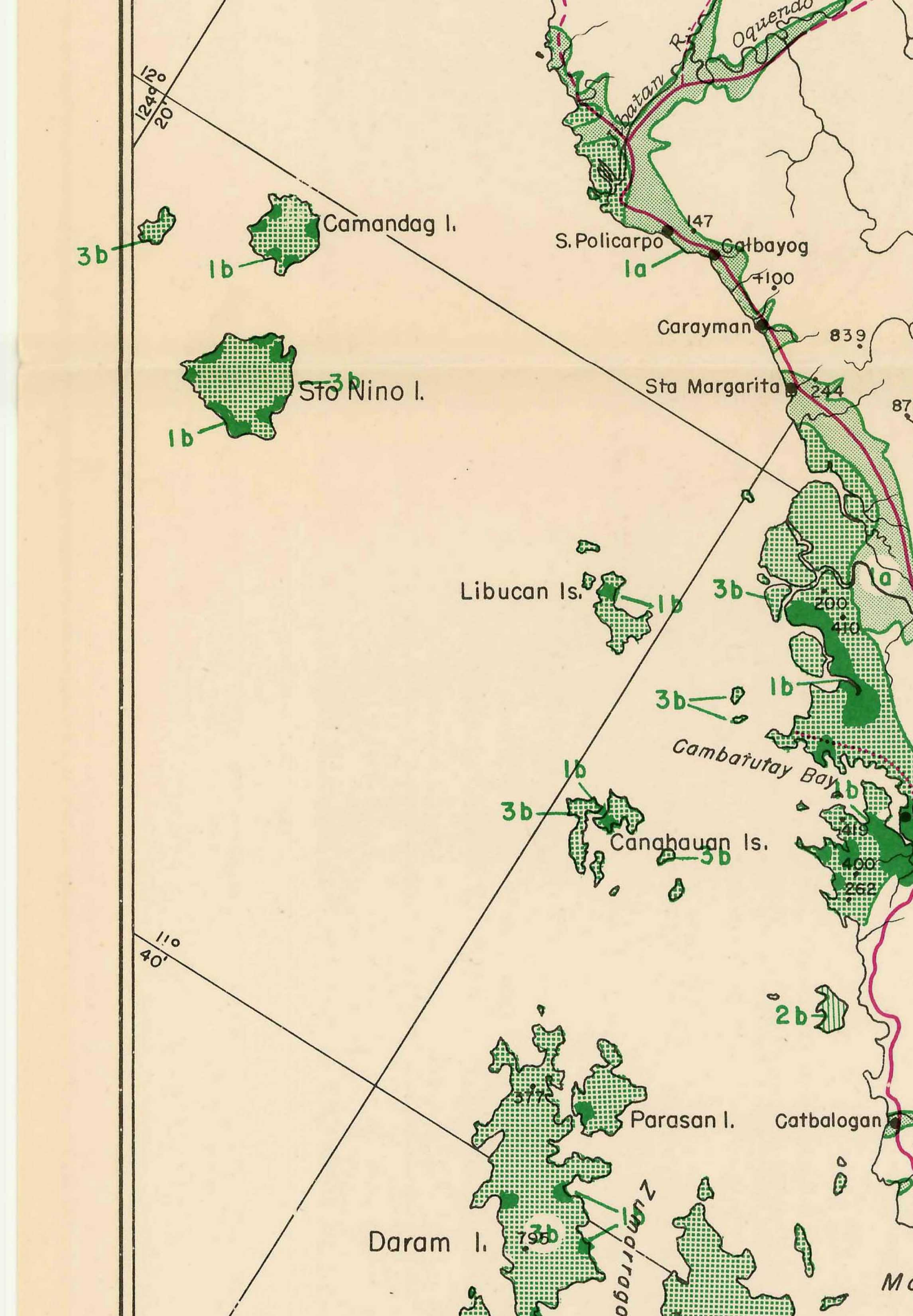
L FEATURES [redacted]

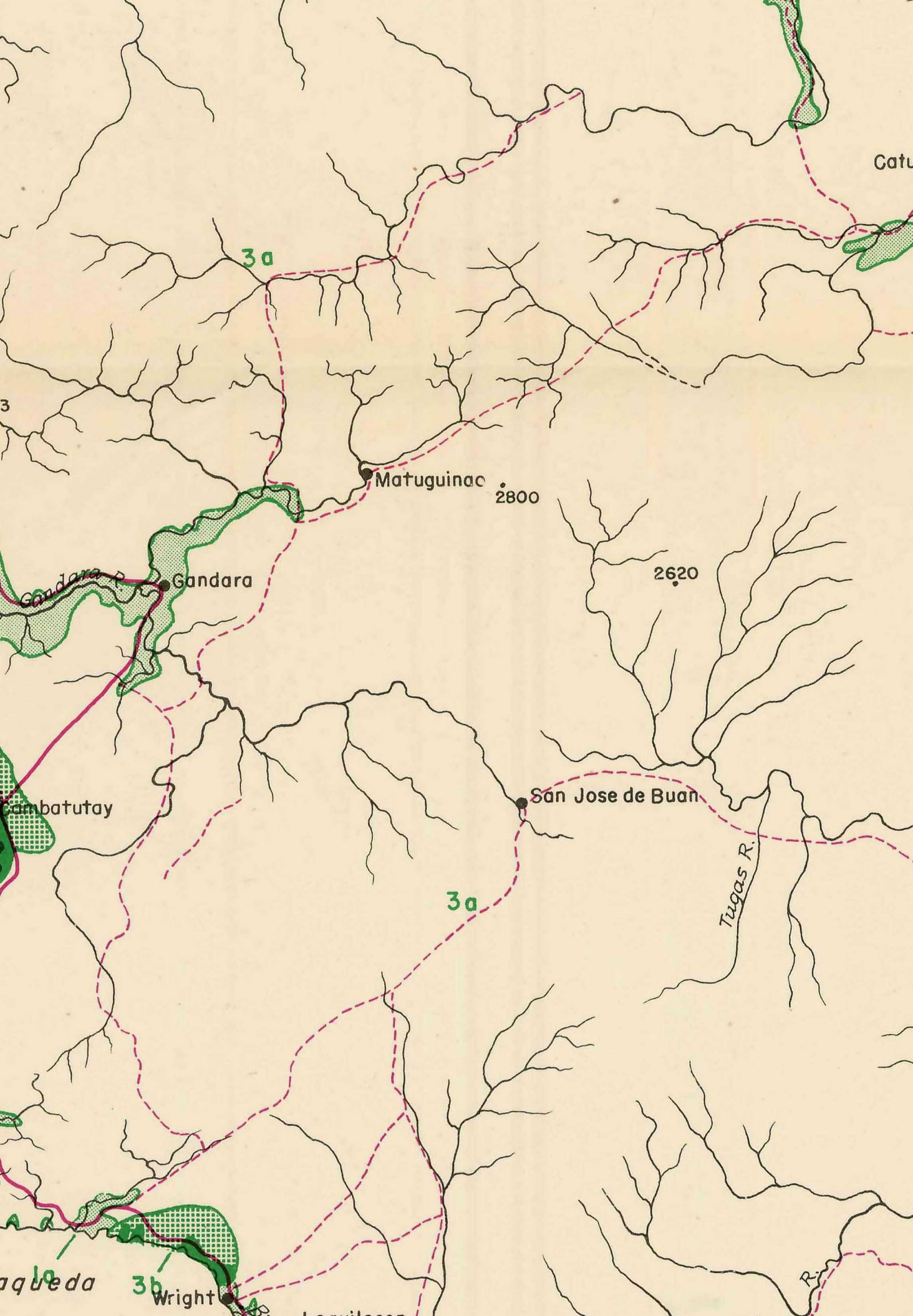


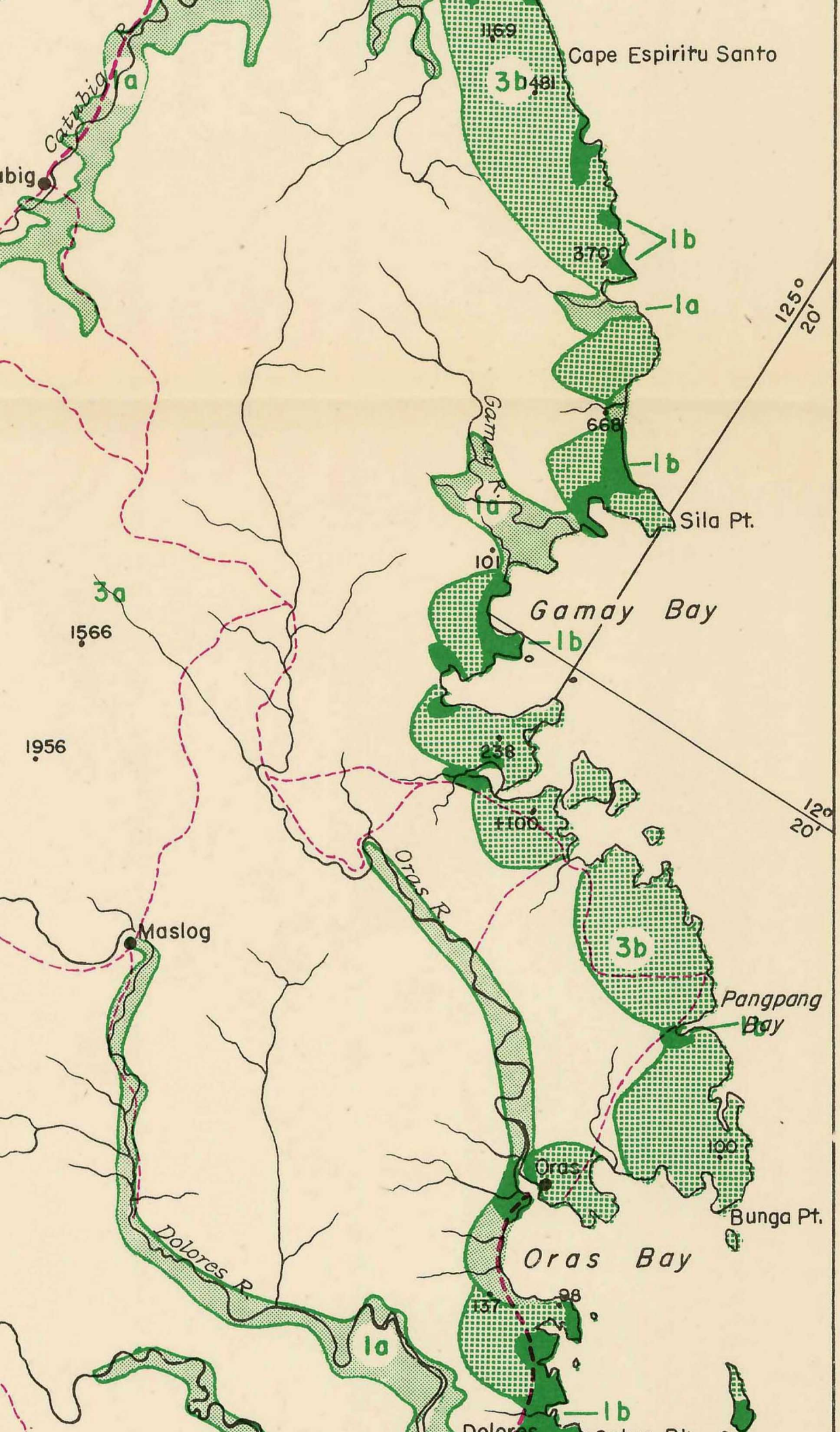
SAMAR AND LEYTE (P.I.)

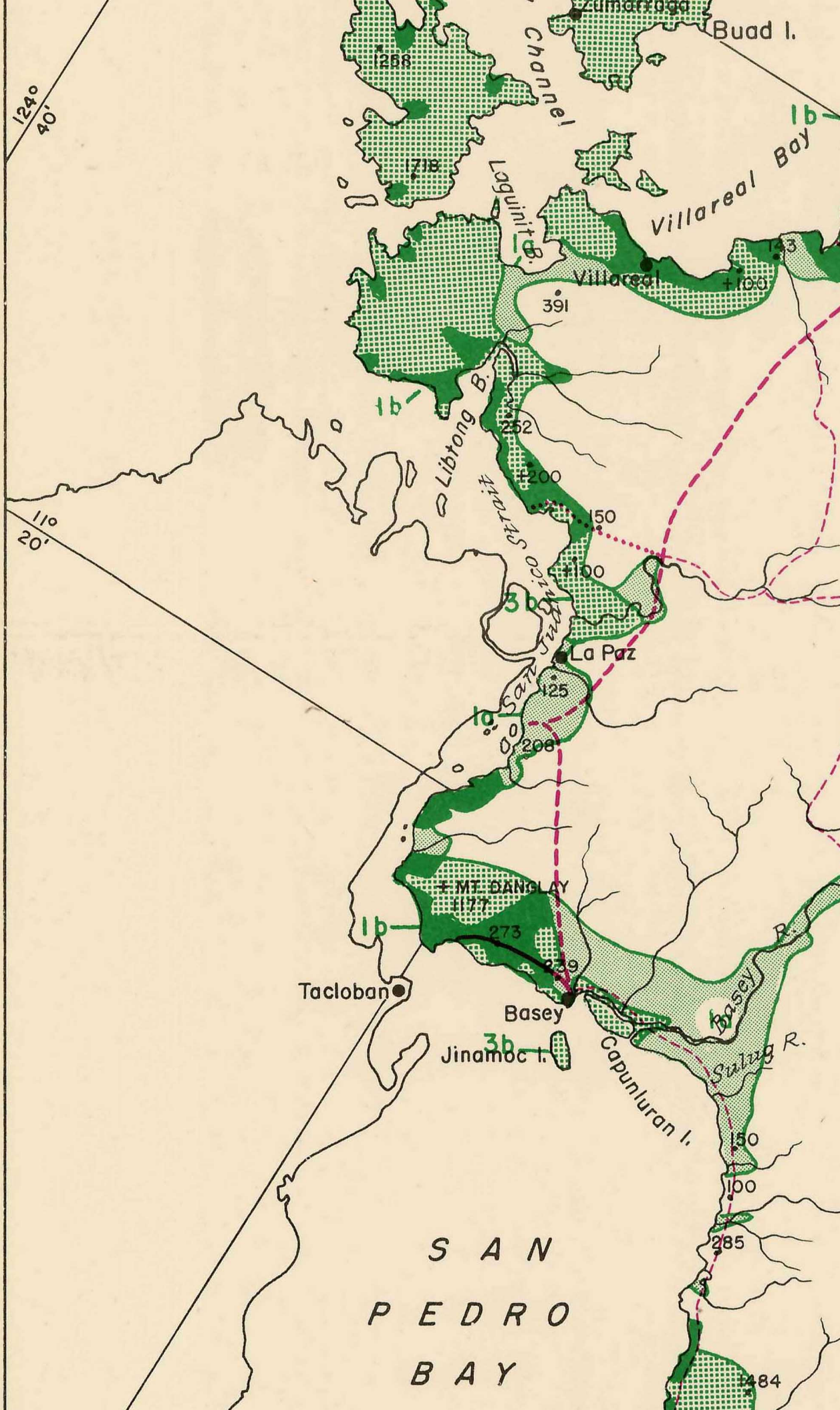
AP UNIT	SUREACE WATER SUPPLY	UNDERGROUND WATER SUPPLY
1a	Plentiful	Plentiful, shallow
1b	Little or none	Moderate to small amounts, shallow.
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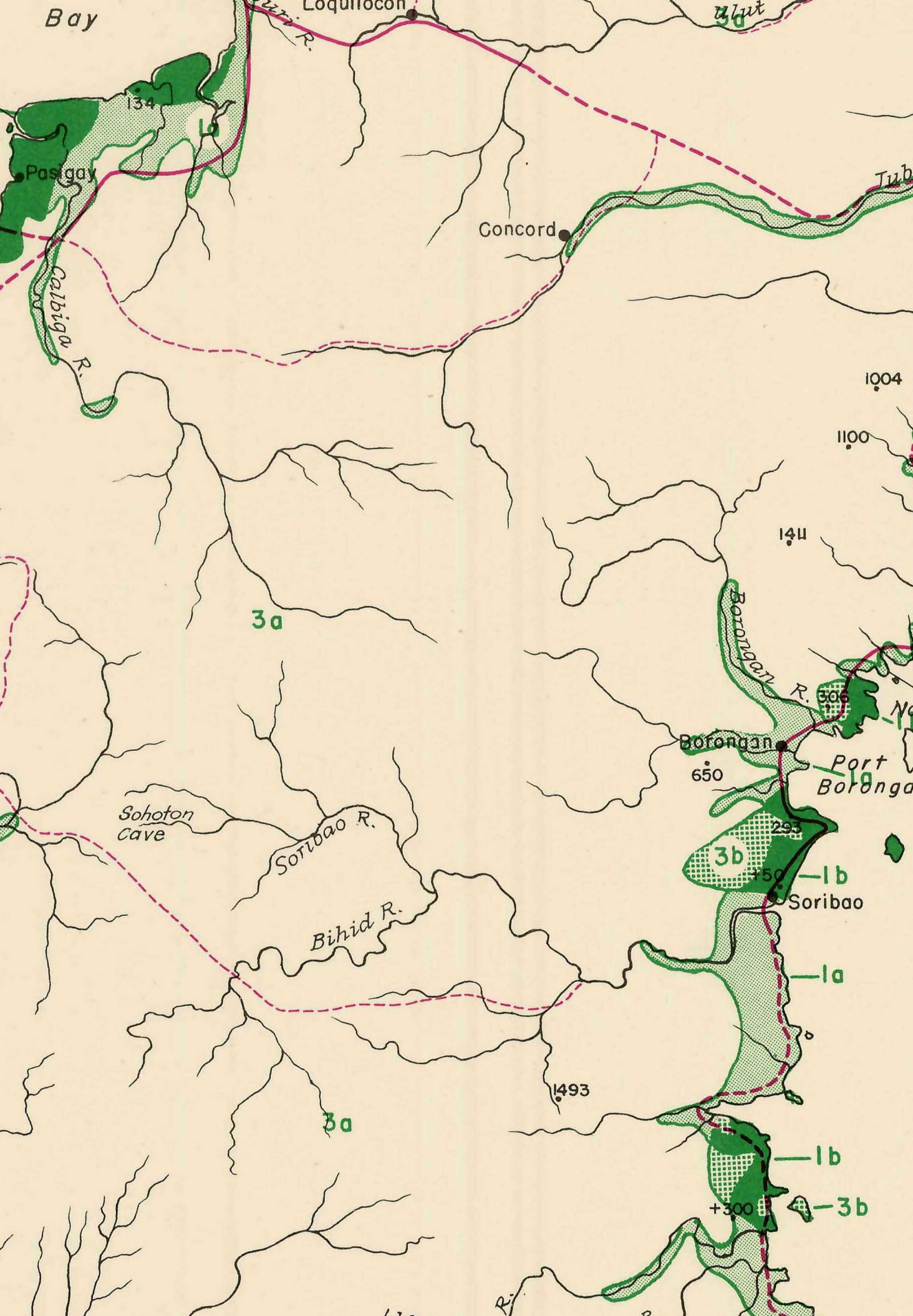


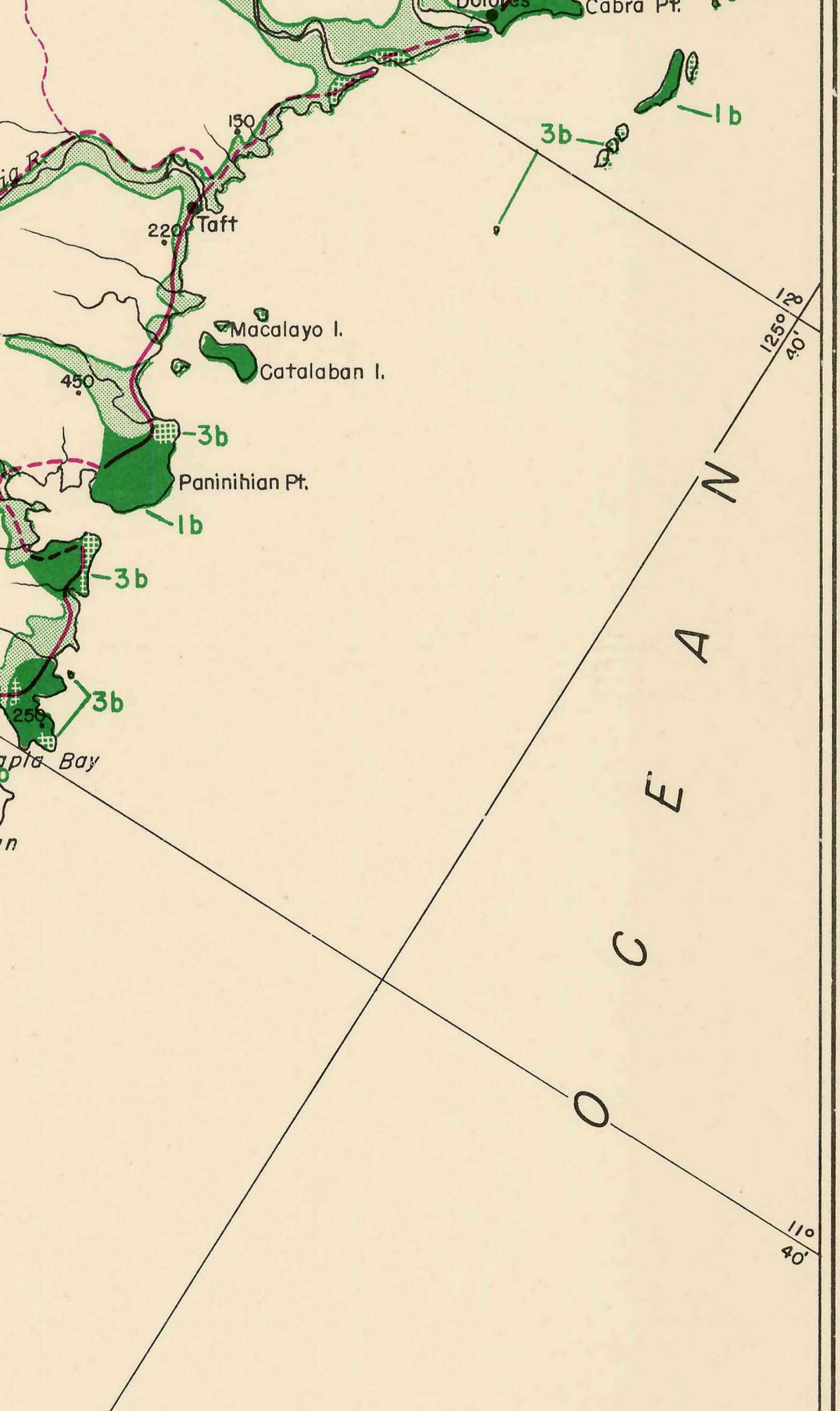

Camandag I.
3b
1b
Sto Nino I.
3b
1b
S. Policarpo
147
Catbayog
1a
4100
Carayman
839
Sta Margarita
244
87
Libucan Is.
1b
3b
1a
200
410
3b
1b
Cambarutay Bay
1b
3b
1b
Canahauan Is.
3b
415
400
262
2b
Parasan I.
Catbalogan
Daram I.
3b
795
Zumarraga
120
124°
20'
110
40'

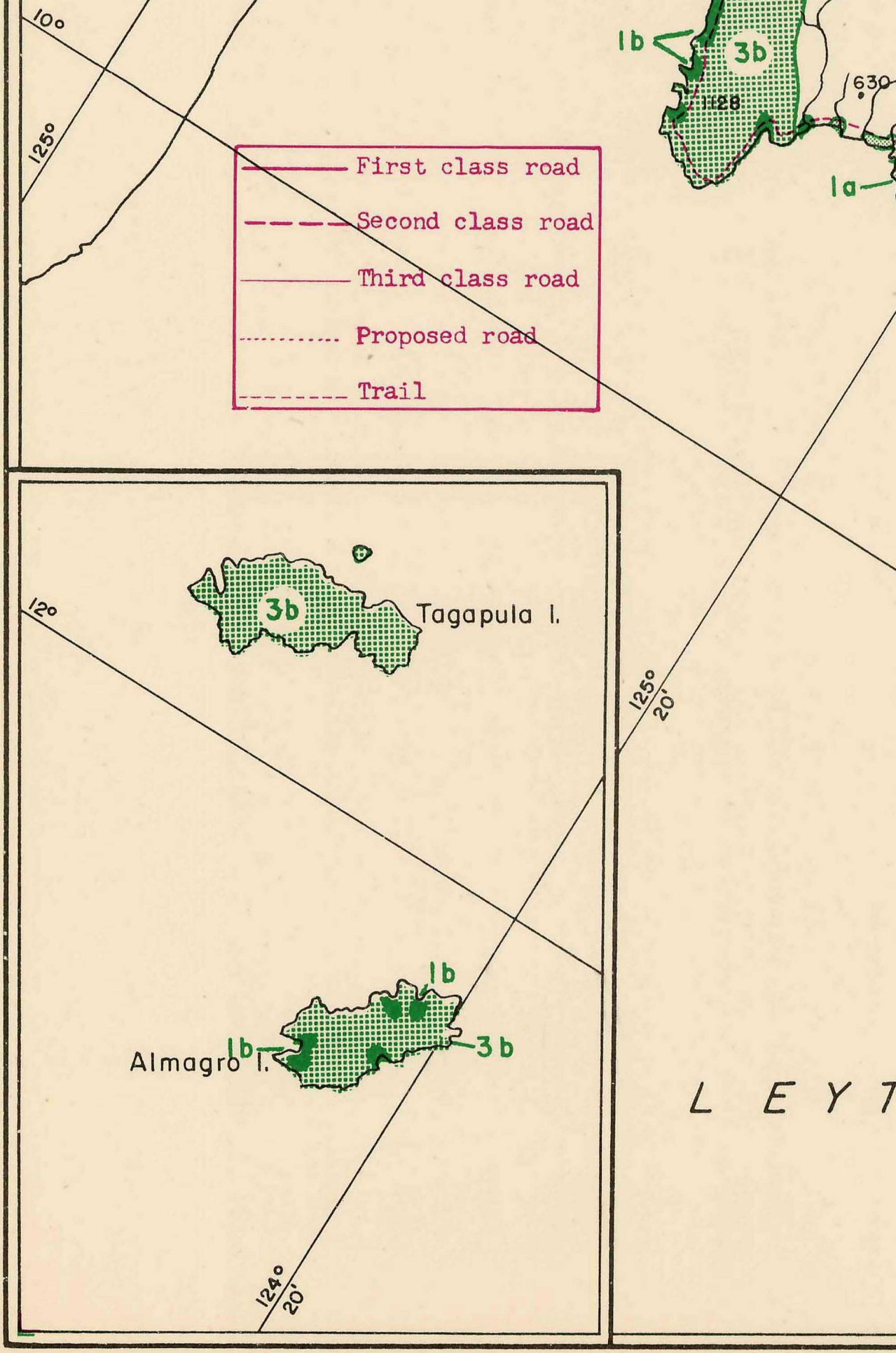

3a
Matuguinao
2800
Gandara
Gandara R.
2620
San Jose de Buan
Tugas R.
3a
3b
Wright

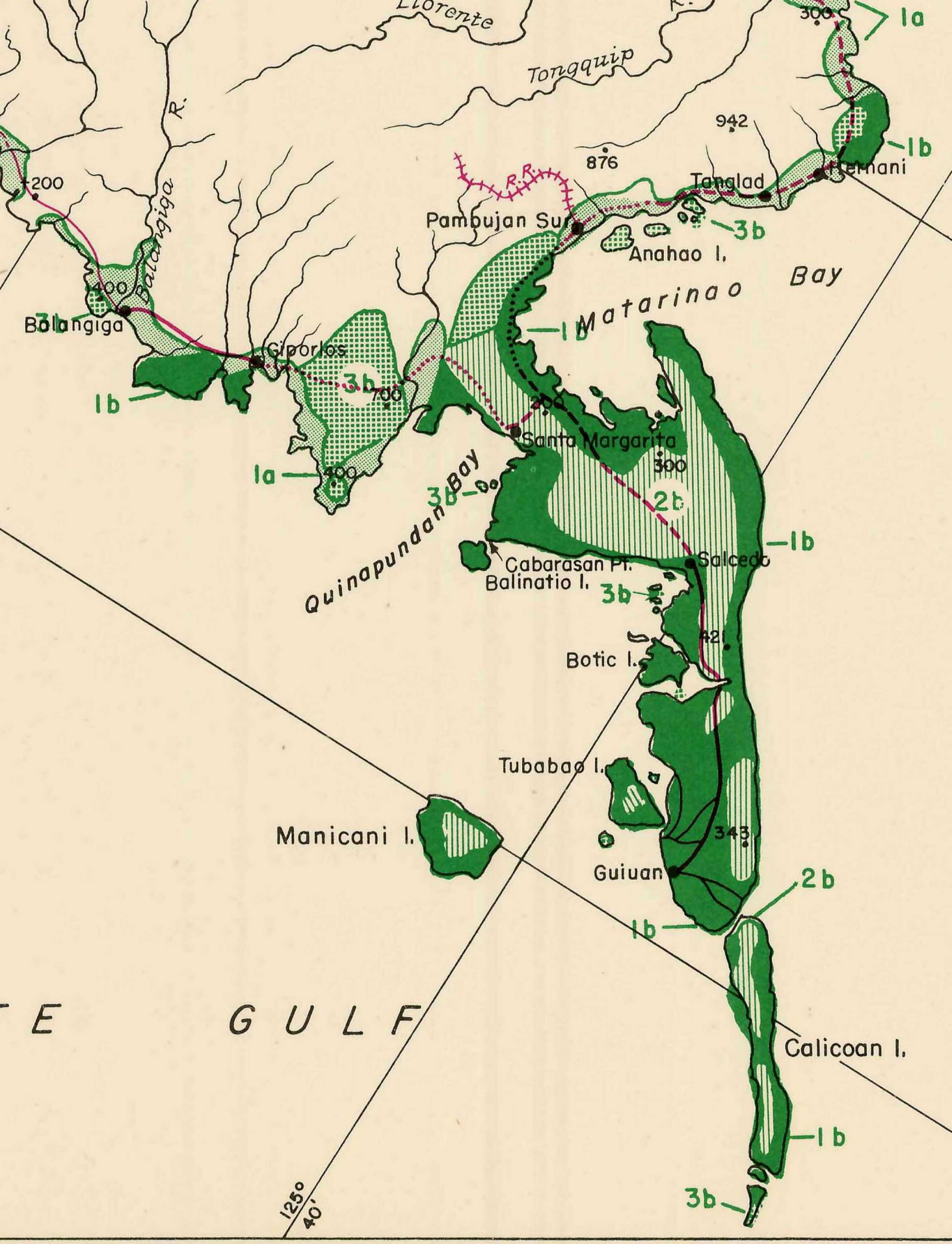

Catubig
1a
1169
Cape Espiritu Santo
3b
481
1b
370
1a
125° 20'
Gamay R.
668
1b
1a
Sila Pt.
101
3a
1566
Gamay Bay
1b
1956
238
±100
12° 20'
Oras R.
Maslog
3b
Pangpang Bay
1a
100
Oras
Bunga Pt.
Oras Bay
Dolores R.
137
98
1a
1b


Zumarraga
Buad I.
1268
Channel
1718
Villareal Bay
Laguinit B.
1b
Villareal
+100
391
252
Libtong B.
Matico Strait
+200
150
+100
3b
La Paz
San Juan
125
1a
208
MT. DANGLAY
1177
1b
273
Tacloban
Basey
Basey R.
Jinamoc I.
3b
Capuluran I.
Sulug R.
150
100
285
SAN
PEDRO
BAY
1484
124°
40'
11°
20'

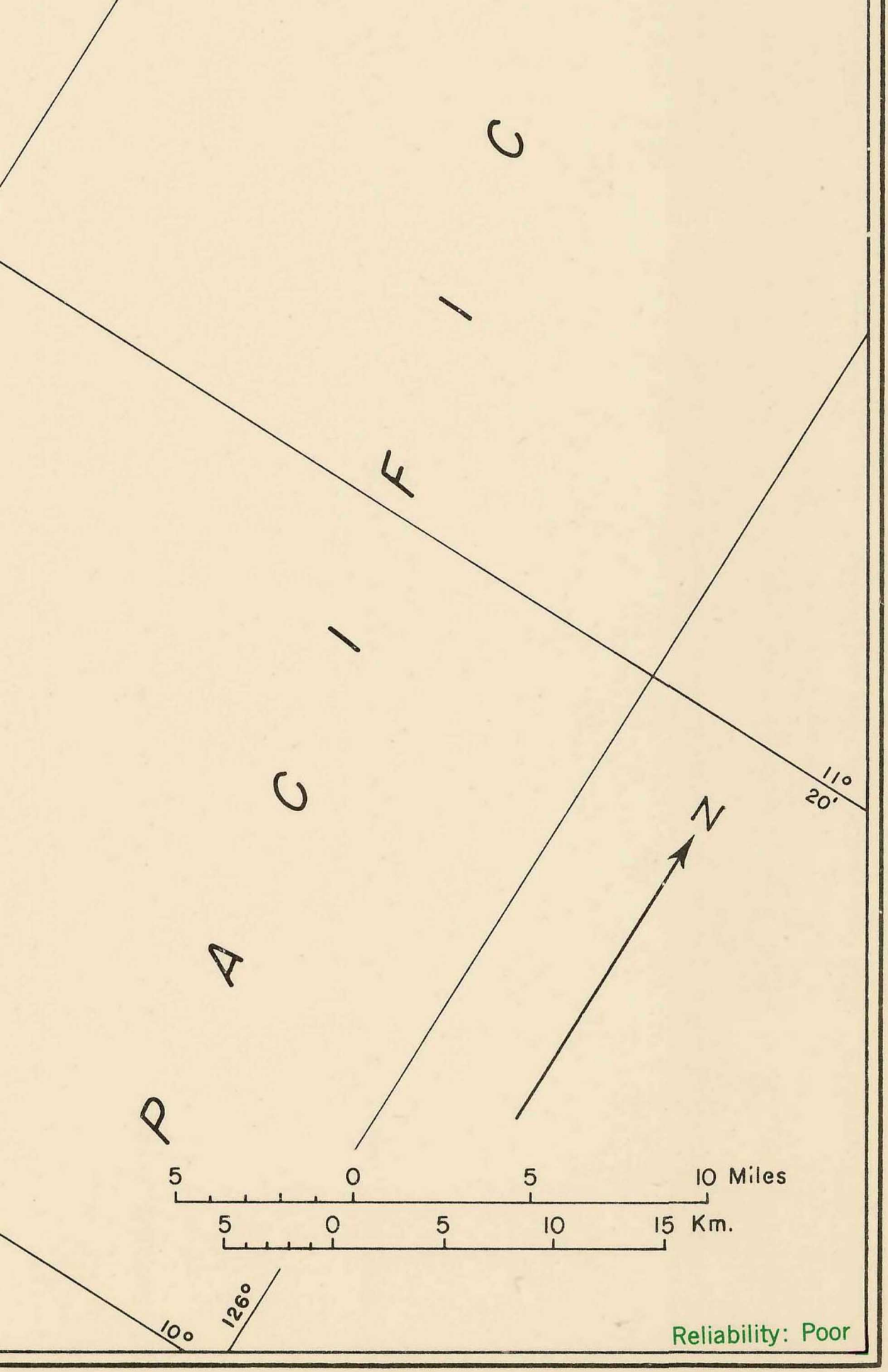

Bay
Loquilocon
Pasigay
Concord
Calbiga R.
Tub
1004
1100
1411
3a
Borongan R.
306
Borongan
650
Port
Borongo
Sohoton
cave
Soribao R.
293
3b
+50
1b
Soribao
Bihid R.
1a
1493
3a
1b
+300
3b


Cabra Pt.
1b
3b
150
Taft
220
Macalayo I.
Catalaban I.
450
3b
Paninihian Pt.
1b
3b
3b
250
Bay
125° 12 40'
O C E A N
11° 40'


First class road
Second class road
Third class road
Proposed road
Trail
1b
3b
630
128
1a
100
125°
120
Tagapula I.
125° 20'
Almagro I.
1b
3b
124° 20'
LEYT

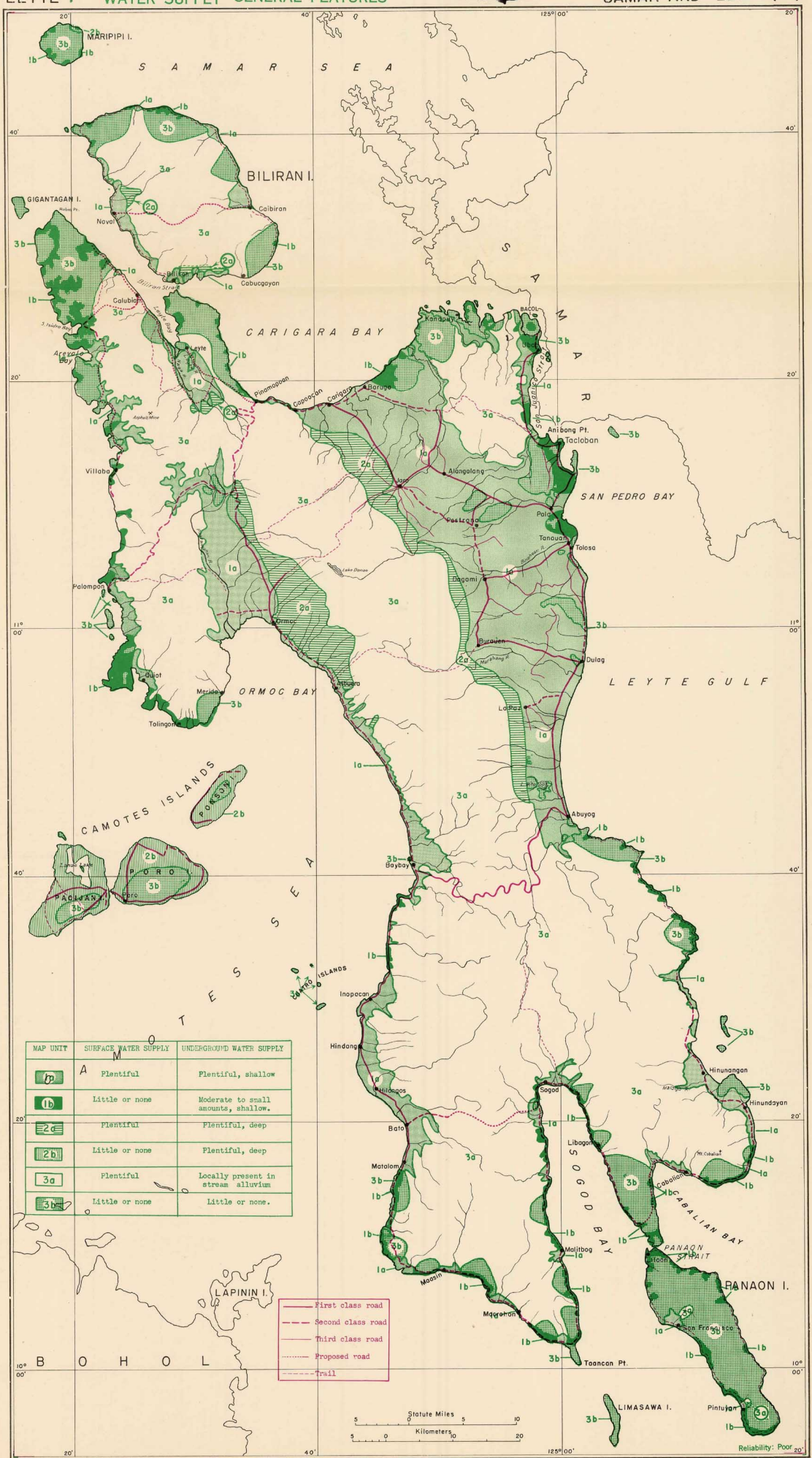


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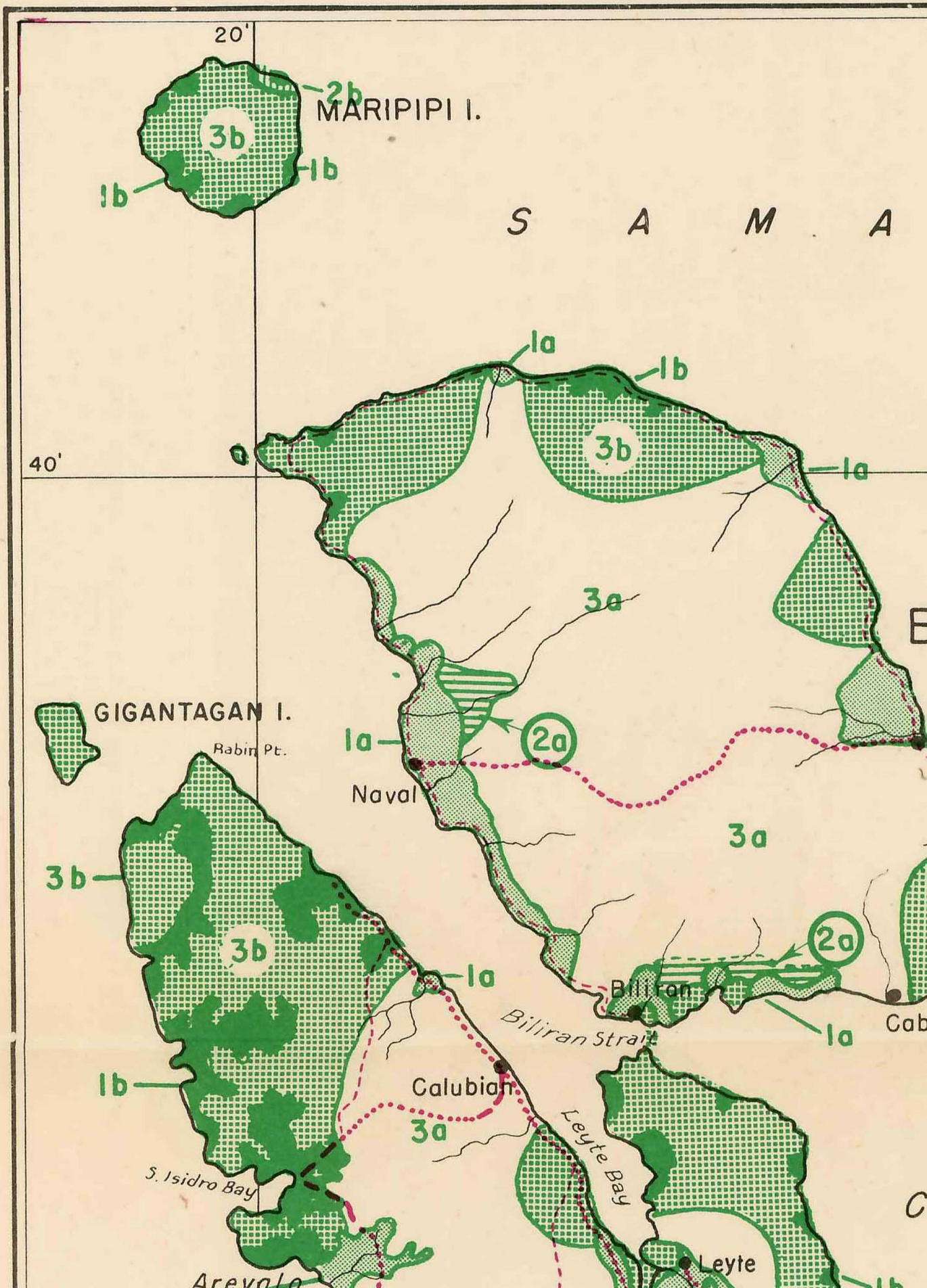
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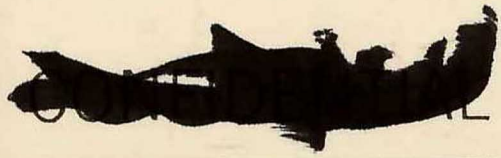
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LEYTE : WATER SUPPLY GE



NERAL FEATURES



40°

125°

R S E A

BILIRAN I.

Caibiran

1b

3b

ucgayan

S A

A R I G A R A B A Y

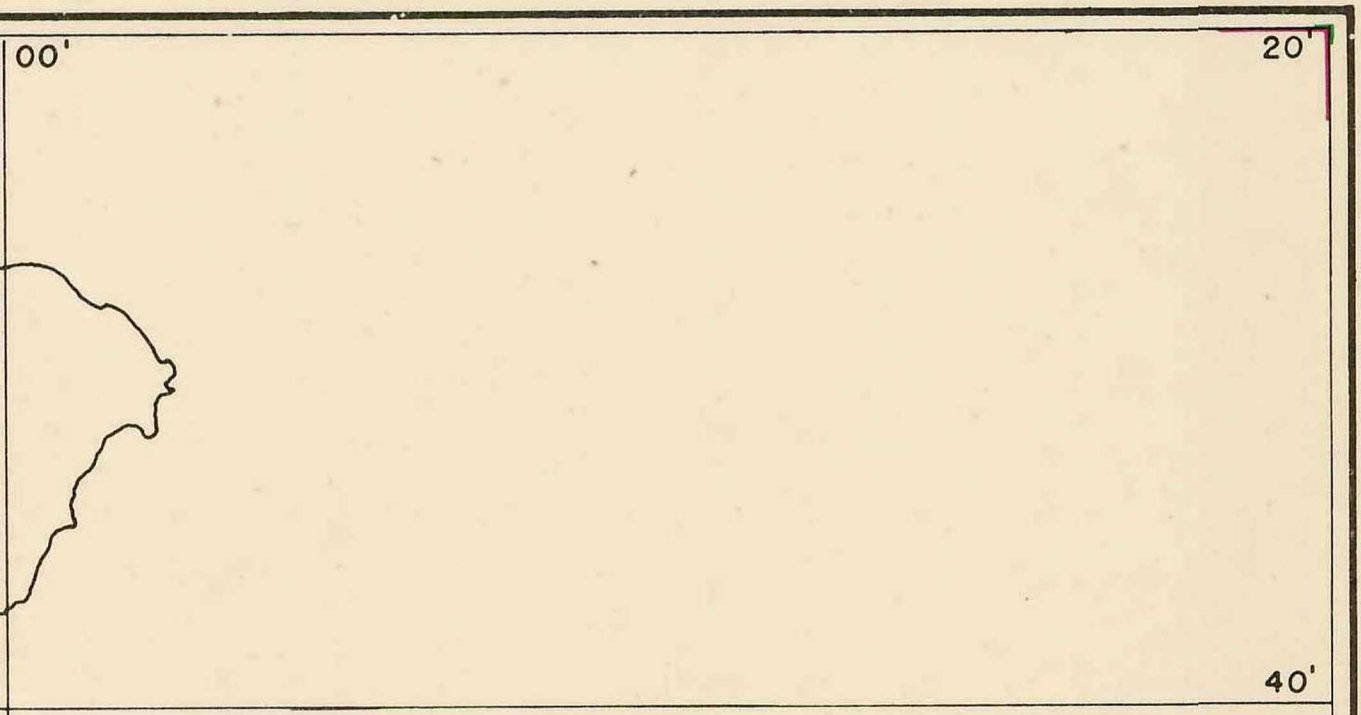
Kanapuy

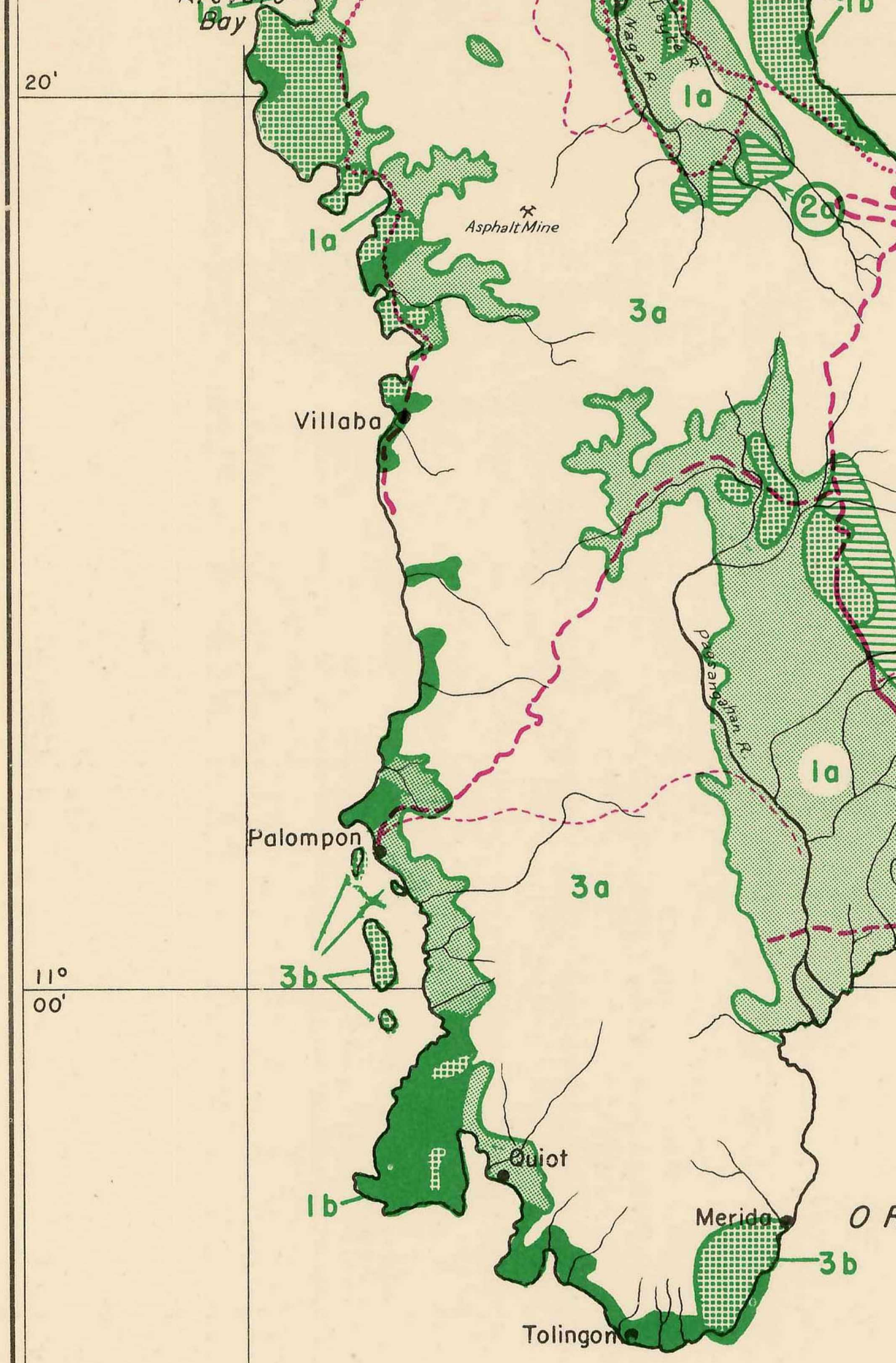
3b

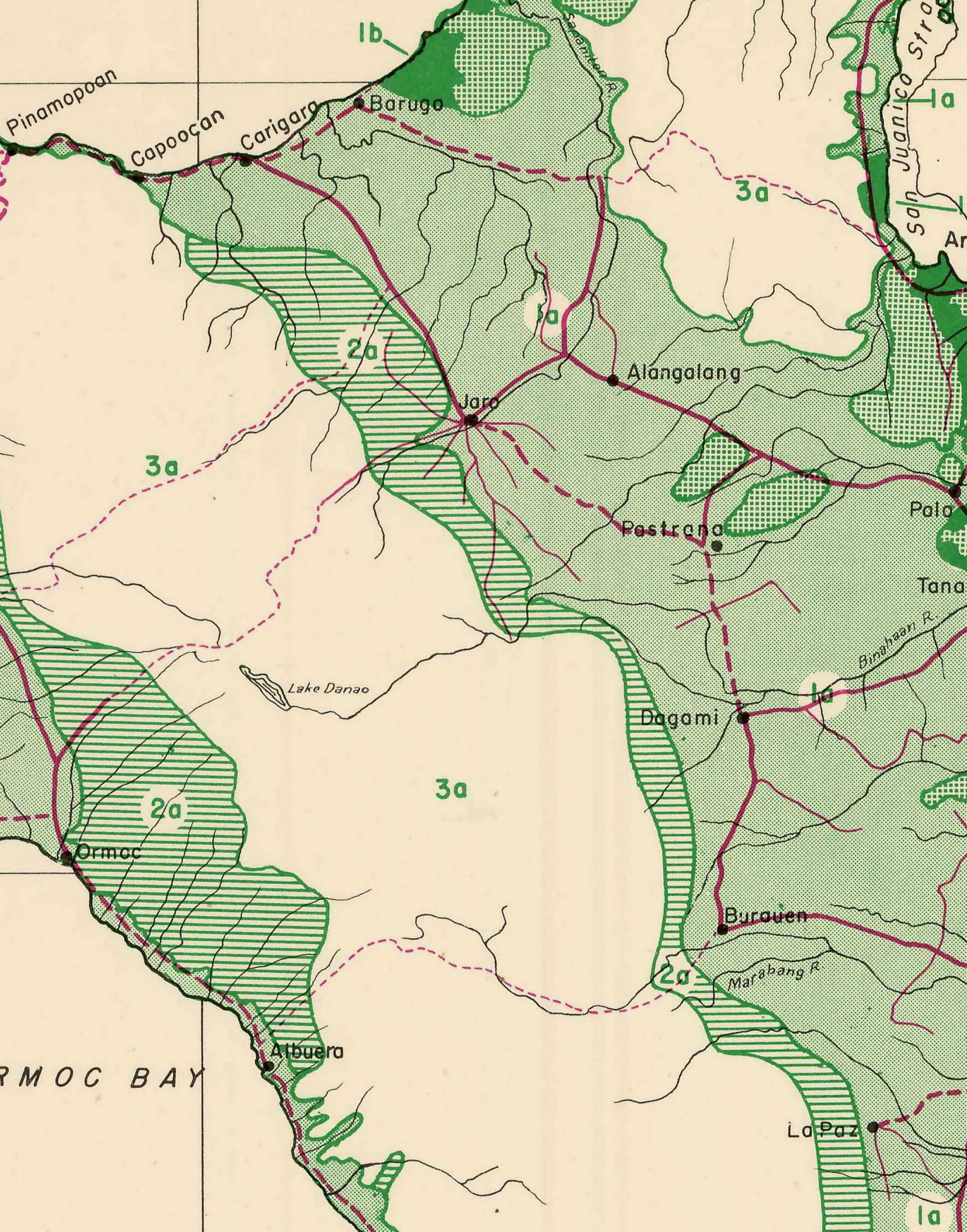
BACOL I.

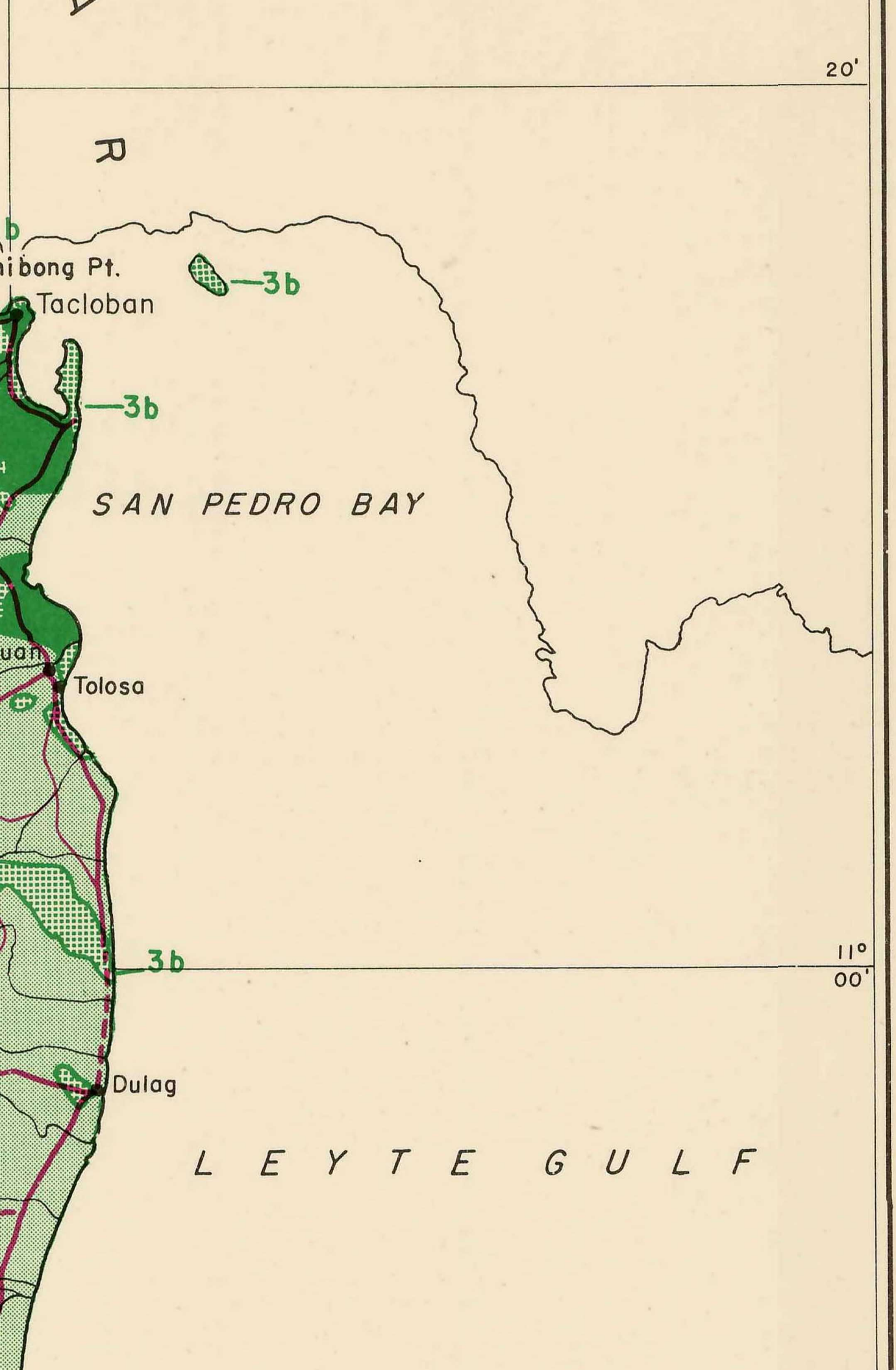
Ubay

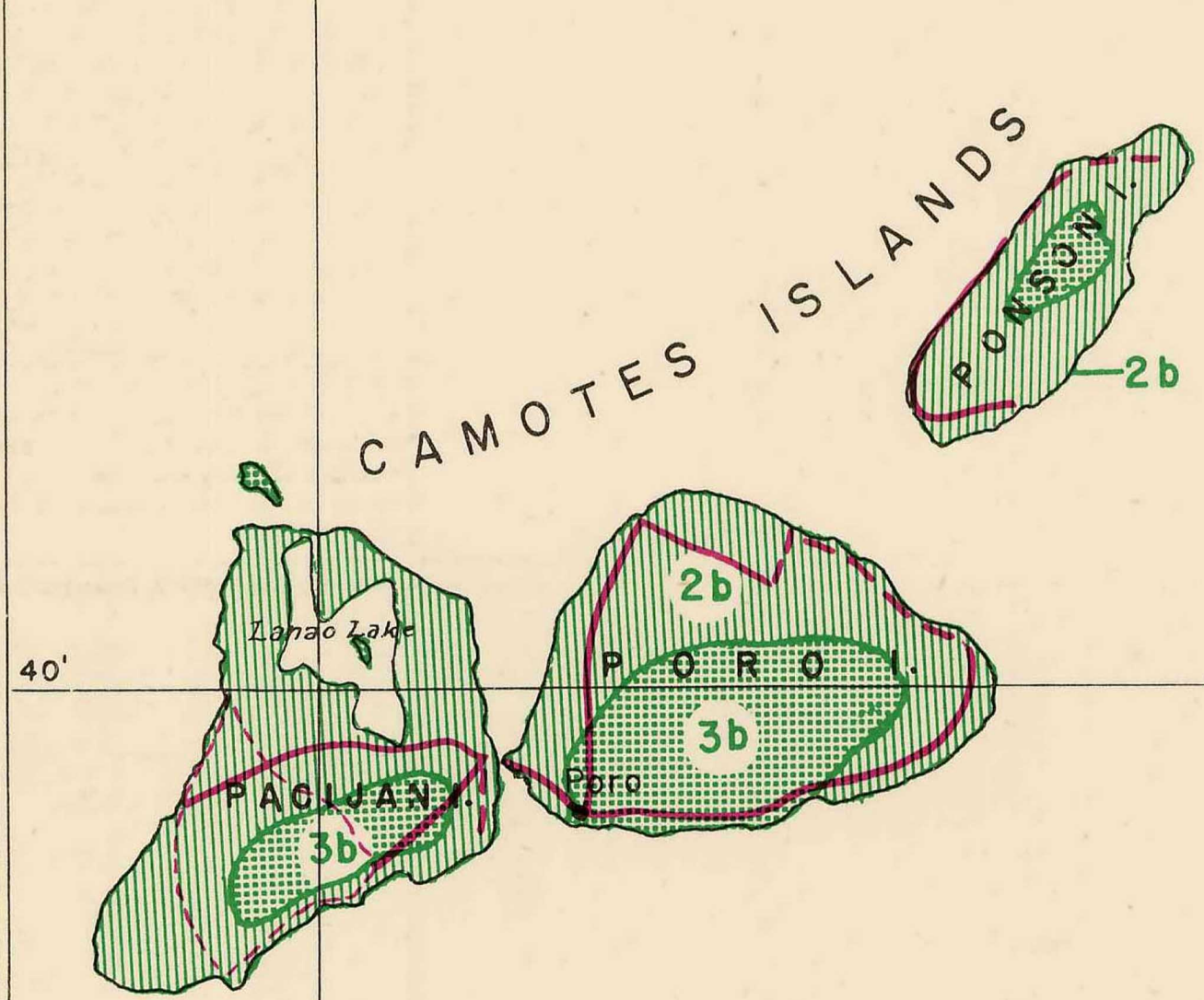
SAMAR AND LEYTE (P.I.)




Bay
20'
Naga R.
Leyte
1b
1a
2a
Asphalt Mine
1a
3a
Villaba
Pasanggahan R.
1a
Palompon
3a
11°
00'
3b
Quiot
1b
Merida
3b
Tolingon

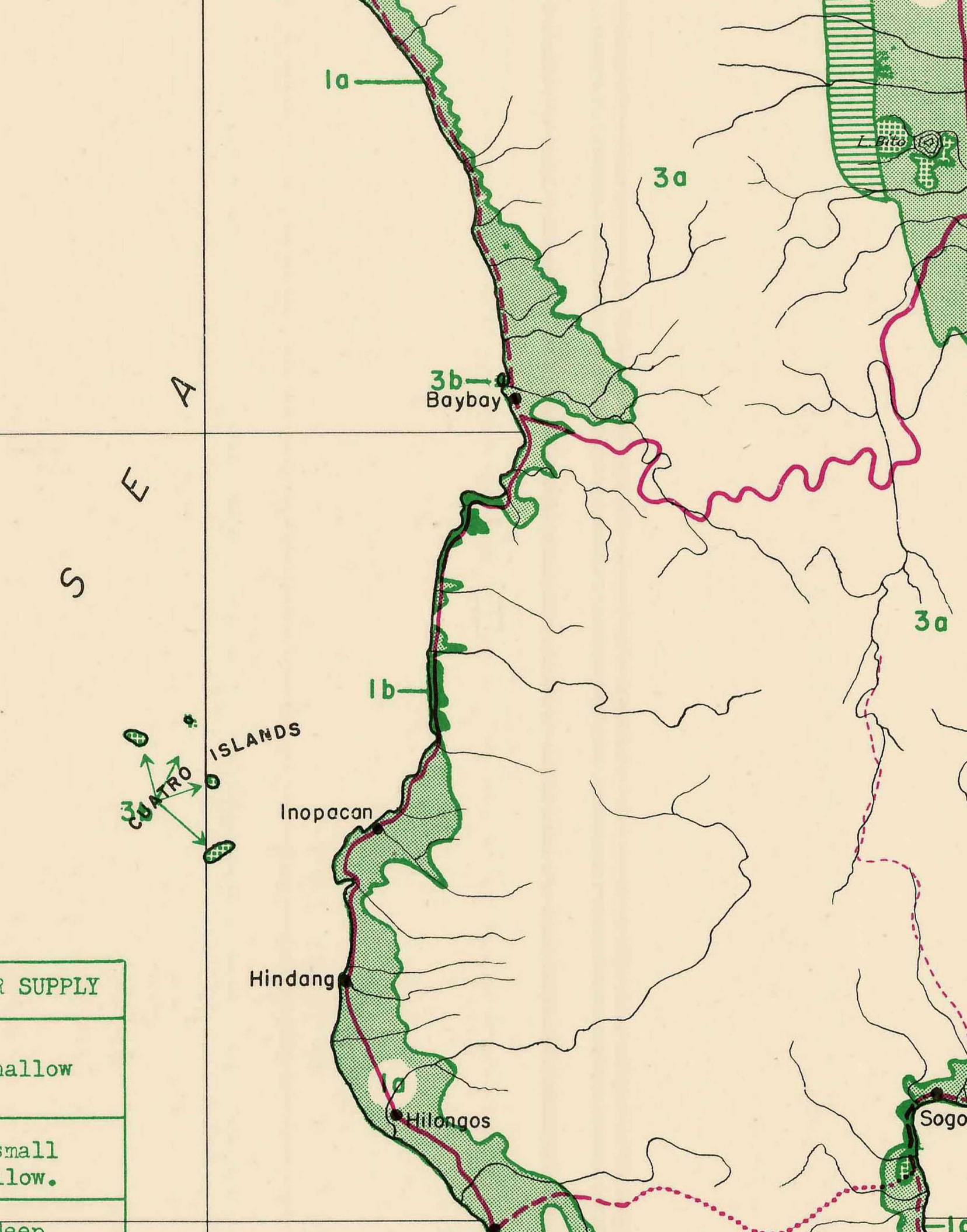

1b
Pinamopoan
Capooçan
Carigara
Barugo
Sapaniton R.
San Juanico Stra
1a
3a
2a
Alangalang
Jaro
Pastrana
Palo
Tana
Binahaan R.
Lake Danao
Dagami
Ormoc
Burauen
Marabang R.
Albuera
La Paz
RMOC BAY

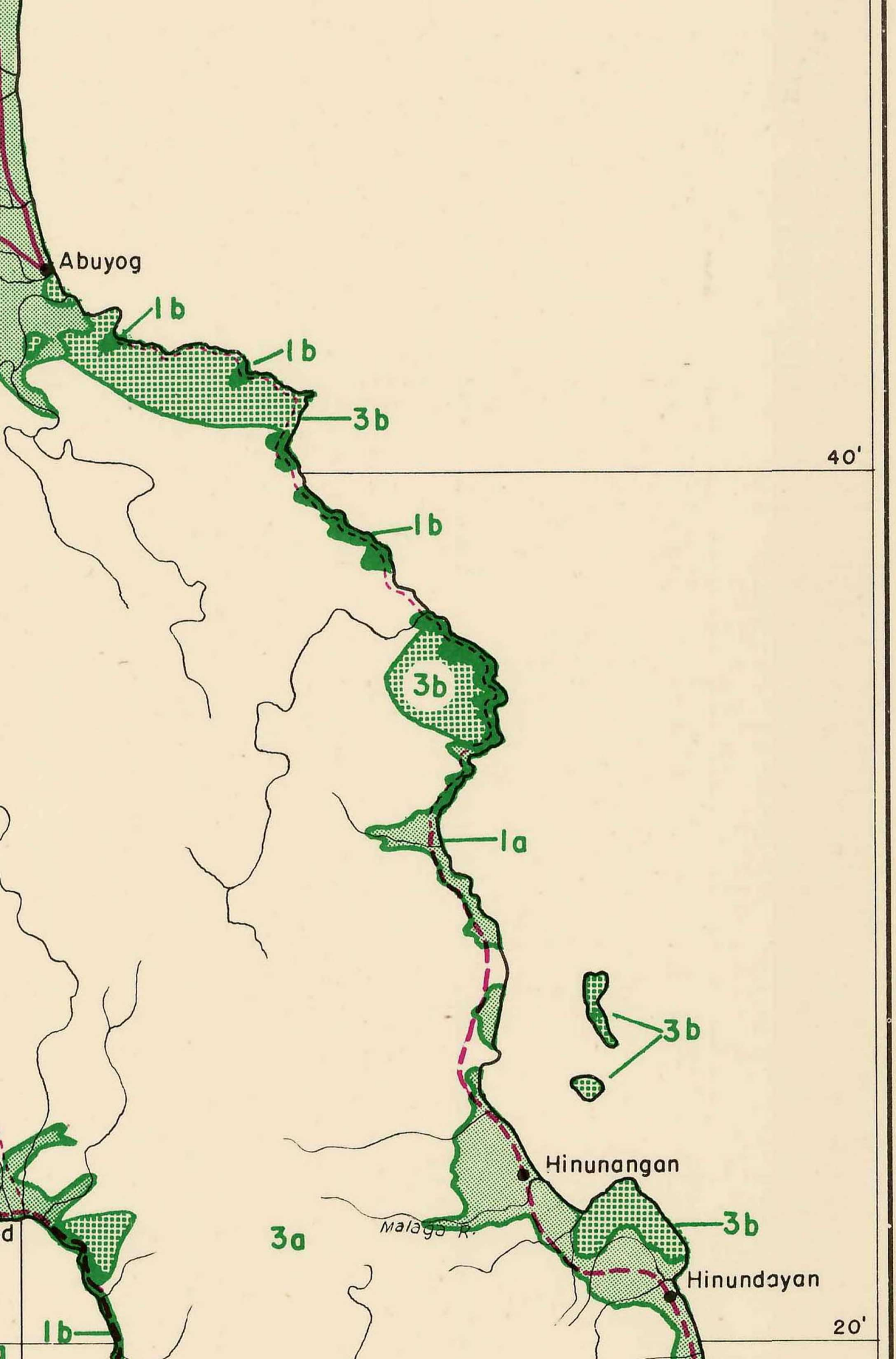

20'
R
ibong Pt.
Tacloban
3b
3b
SAN PEDRO BAY
uan
Tolosa
3b
11°
00'
Dulag
L E Y T E G U L F



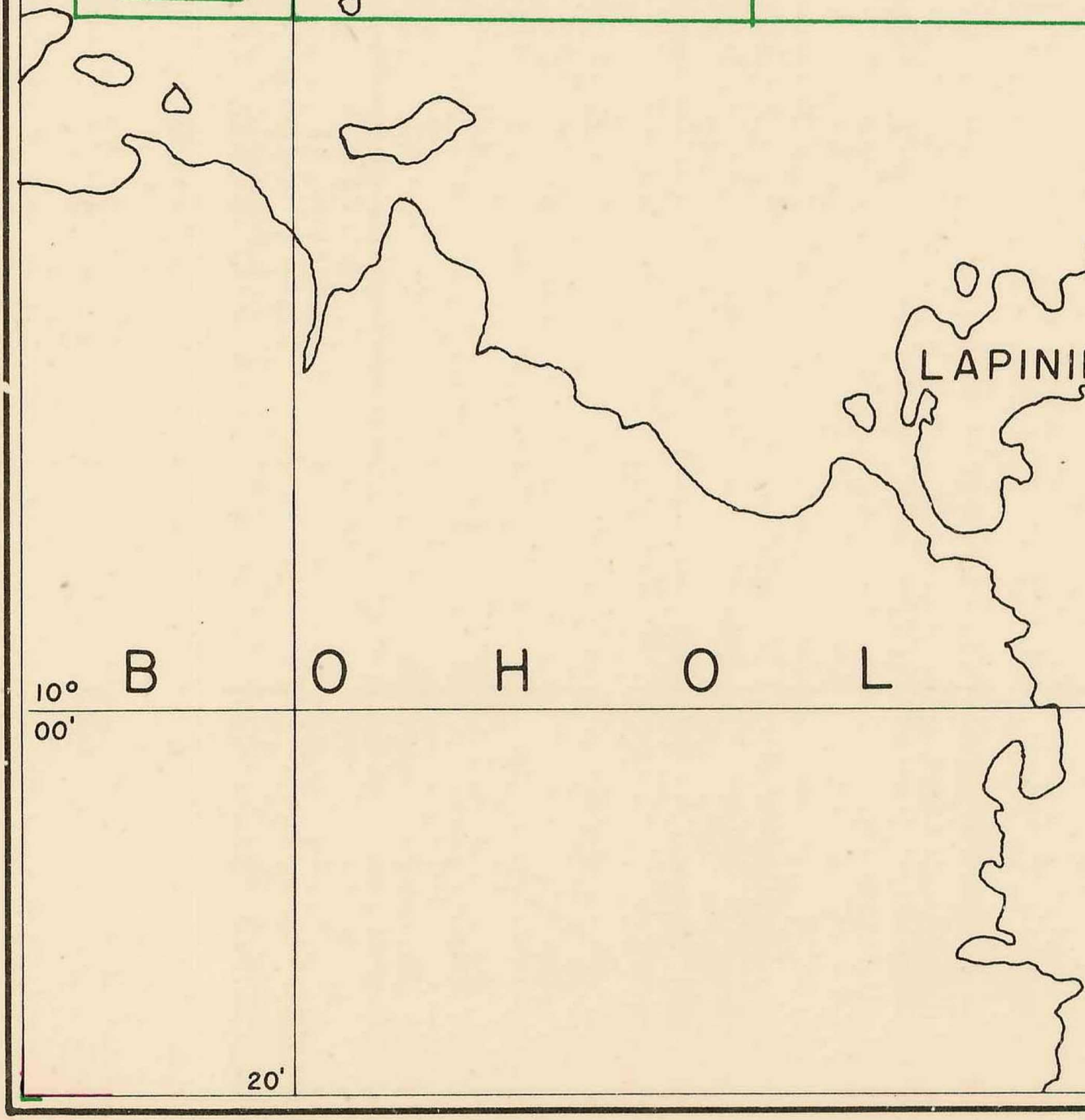
MAP UNIT	SURFACE WATER SUPPLY	UNDERGROUND WATER
2b	Plentiful	Plentiful, sh
1b	Little or none	Moderate to s amounts, shal
	Plentiful	Plentiful, c

20'


1a
3a
3b
Baybay
S E A
3a
1b
ISLANDS
CUATRO
3
Inopacan
Hindang
1a
Hilongos
Sogo
R SUPPLY
allow
small
llow.

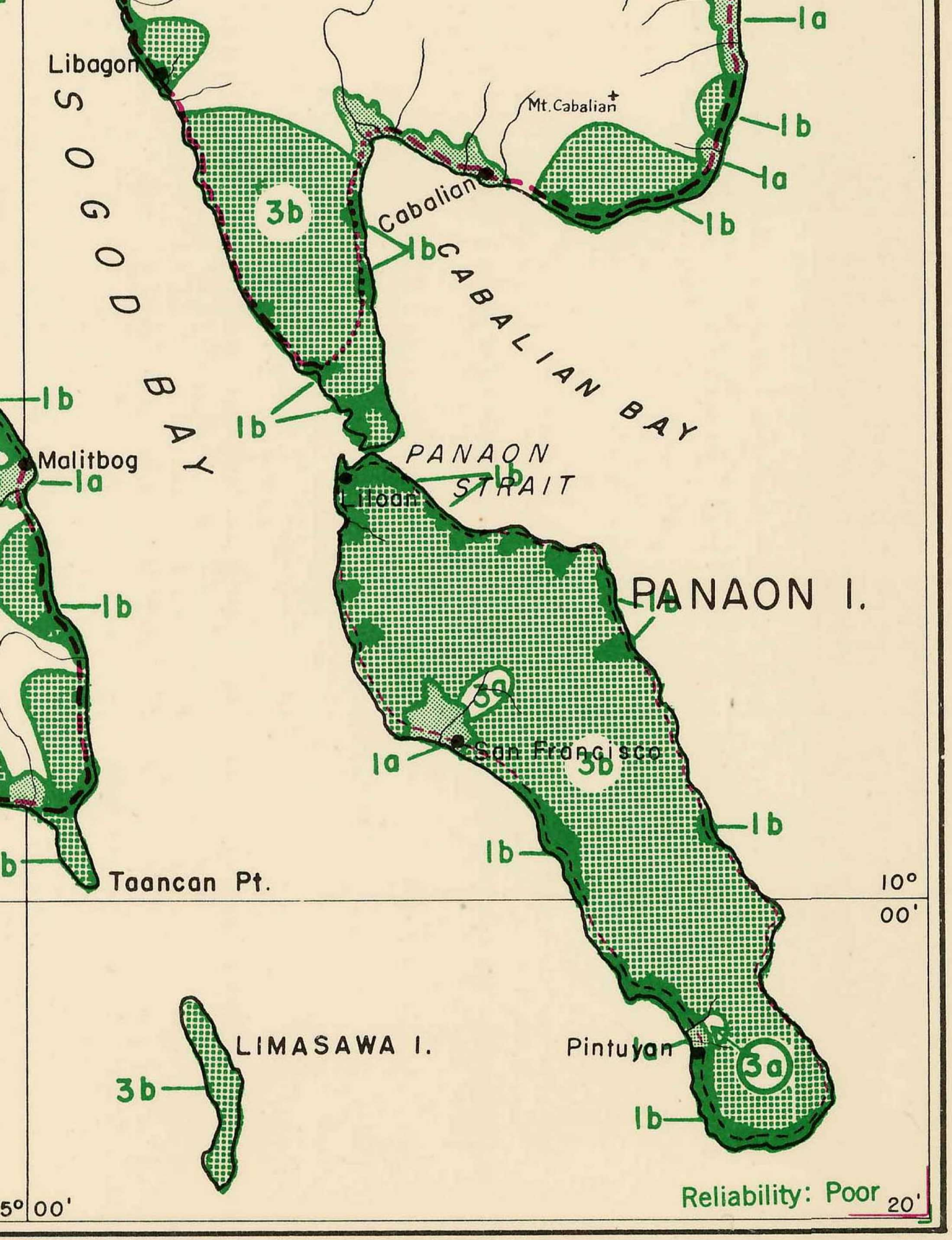

Abuyog
1b
1b
3b
40'
1b
3b
1a
3b
Hinunangan
3b
Malaga R.
3a
Hinundayan
20'
1b

2a	Plentiful	Plentiful, c
2b	Little or none	Plentiful, d
3a	Plentiful	Locally prese stream allu
3b	Little or none	Little or n



Bato
Matalom
3a
3b
1b
1b
3b
1a
Maasin
1b
Macrohon
1b
3
N I.
First class road
Second class road
Third class road
Proposed road
Trail
Statute Miles
5 0 5 10
Kilometers
5 0 10 20
40'
12

[redacted]



PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE(P.I.)

WATER SUPPLY: GENERAL FEATURES

Reliability: Fair.

MAP UNIT Summary Terrain Features	SURFACE WATER Streams, Canals, Lakes[a]	SURFACE WATER Springs[a] (gpm = gallons per minute)	SURFACE WATER Suggested Methods of Utilization	UNDERGROUND WATER Geology; Ground-water Occurrence and Quality	UNDERGROUND WATER Existing Wells[a] (gpm = gallons per minute)	UNDERGROUND WATER Location and Construction of Additional Wells	RECOMMENDED SOURCES
1a Many closely spaced perennial streams; plentiful shallow ground water. Lowland Plains and Benchlands Coastal plains, beaches, lower benchlands, and river flood plains. Much cultivated land. Principal corridors of movement. Generally easy movement for mobile purification units and well-drilling rigs, although in places swamps, wet paddy fields and unfordable streams restrict movement. Motor roads in many districts.	Perennial streams very numerous and closely spaced. Unit contains lower and middle courses of principal rivers. In many districts, small canals divert water to paddy fields. Fresh-water swamps locally. Very few lakes. Lake Bito, on Bito River, near east coast of Leyte; area 2/5 sq mile, maximum depth 45 feet; surface altitude 10 feet above high tide. Quality of Water: Water contains very little dissolved mineral matter; is soft and generally neutral or slightly acid. Normally most rivers are fresh to their mouths, but at low stages on some rivers brackish water may extend short distances upstream from mouth. At normal stages, water commonly is slightly turbid. Sanitary quality generally poor; water must always be properly purified for potable supply. Swamp water is potable only in emergency, because high organic content causes foul odor and taste, difficult to remove by ordinary purification methods.	Generally sparsely distributed, but common in some areas. Typically issue at base of benchland scarps or near inland borders of areas; a few issure on beaches and are inundated at high tide. Majority yield only a few gpm, few yield more than 50 gpm. Springs issuing near settlements generally are used for domestic supply, and commonly are improved in primitive fashion. Quality of Water: Water generally is somewhat harder than surface water, but otherwise of excellent chemical quality. Usually free from bacteriological pollution if outlet zone is properly protected.	Transportation from water points rarely need exceed 1 mile, commonly will be much less. Easy terrain for construction of canals, distribution roads, or laying pipe lines. Movement locally restricted by swamps and paddy fields. Supplies adequate for large troop concentrations without construction of storage reservoirs. Many springs will give increased yields by proper improvement. For safe potable supplies, all water from streams and canals should be filtered through diatomaceous earth filters and treated with halazone. During high stream stages, passing water through settling basins will reduce clogging of filters. Spring water locally safe, but commonly requires treatment with halazone.	Geology: River flood plains, deltas, and coastal plains underlain by unconsolidated beds of gravel and sand alternating with beds of silt and clay; in places some coral limestone. Deposits range from a few feet to several hundred feet thick. Ground-Water Occurence: Generally excellent water-bearing sand, gravel, or coral limestone strata at shallow depth. Water table usually within 5 to 40 feet of land surface, shallowest beneath low-laying flats. Abundant artesian water obtainable from deeper strata where deposits are thick, i.e., on outer parts of wide coastal plains, larger river deltas, and on Northeast Leyte plain. Quality of Water: Typically harder than stream water, in places very hard, but otherwise usually of excellent chemical quality. Within 1/4 mile to 1/2 mile of the coast or salt-water estuaries, the shallow ground water is relatively fresh, but deeper water generally is brackish or salty. Many artesian aquifers below 250 feet depth are saline, and below 1,000 feet potable water is rarely encountered. In inhabited areas, shallow ground water commonly is bacteriologically polluted for as much as 25 feet below the water table; water from greater depth usually is free from pathogenic organisms.	Shallow Wells: Majority of towns and villages derive part of all of supply from shallow dug wells, commonly 20 to 30 feet deep, from which water is raised by bucket or hand pump. Yields usually less than 10 gpm, but commonly can be materially increased by installing power pumps and deepening wells a few feet. Artesian Wells: At Carigara, Jaro, Ormoc, Naungan, Baybay, Catbalogan, Wright, Villareal, and Hernani 1 or more artesian wells furnish part of the town water supply. These wells range from about 150 to 1,000 feet deep; most flow at the surface but yields are generally less than 1 gpm by free flow; by pumping, commonly can be increased several times. At Wright, salt water was found between 590 and 705 feet, but was cased off; at 1,020 feet fresh water was encountered, under sufficient pressure to flow at the surface.	Location: Most favorable areas for development of ground-water supplies. Shallow ground water plentiful, adequate for large troop concentrations. Six-inch drilled wells 30 to 100 feet deep generally will yield from 10 to 100 or more gpm; yields highly variable from place to place; larger diameter dug wells give much greater yields for equivalent depth. Experience in Philippine Islands has shown that about 50% of wells in coral limestone are successful. Wells should be located up-slope and at considerable distance from privies, latrines, garbage pits, and other sources of pollution. Within 1/2-mile of the coast and on small islands, wells should be located as far inland as possible and should not be sunk below layer of fresh ground water into the underlying zone of salty ground water. Pumping should be carefully regulated so that discharge does not become too saline. Drilling: Rate rapid. Rotary drilling rigs preferable, most rapid; percussion rigs also suitable. If drilling rigs unavailable, shallow wells can be constructed in a few hours by drive points, jetting, boring, or digging with pick and shovel. Such methods only practicable on alluvial lowlands where water table is within 20 feet of land surface; require only light equipment. In coral rock, wells generally must be dug or drilled. Casing necessary. Well screens advisable for sand aquifers. After drilling, proper development by surging, heavy pumping, or back-washing will insure maximum well capacity. Water should be chlorinated or treated with halazone, particularly wells supplied by aquifers less than 30 feet below water table. If wells tap deeper aquifers and shallow aquifers are properly sealed off, water probably will be sterile.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, municipal distribution systems, streams, and irrigation canals. Temporary Camp, Field Hospitals:[b] Springs, existing wells, or additional shallow wells (drilled, dug, drive point, bored, etc.). Semipermanent or Permanent Camps, Base Hospitals:[b] Additional drilled wells, if drilling equipment available, otherwise additional dug, bored, drive point wells; springs.
1b Few or no perennial streams or brackish streams; fresh ground water generally obtainable at depth of a few feet but very limited in some areas. Lowland Plains and Benchlands Similar to Unit 1a, except areas typically small, with few or no perennial streams.	On main islands, streams are small brooks, mostly non-perennial, but carry appreciable flows in rainy season. Unit also includes zone of salt-water intrusion at mouths of larger rivers. On smaller islands, streams generally flow only after heavy rains. Quality of Water: Water contains very little dissolved mineral matter, except in brackish-water zone at mouths of some rivers and coastal sloughs. Sanitary quality generally poor.	Typically less numerous and smaller than in 1a areas; otherwise similar to 1a areas.	Widely scattered sources may entail relatively long transport from water points. Construction of storage reservoirs commonly is necessary to insure perennial supplies from streams. Best reservoir sites generally are narrow valleys in Units 2 or 3. Water should be properly purified.	Similar to 1a. Alluvial deposits commonly are shallow, and in some places contain only limited quantities of ground water.	Shallow dug wells at most settlements; usually yield only a few gpm. No known artesian wells. Probably some wells near shoreline are brackish.	Same as 1a, except typically only small supplies obtainable.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, municipal distribution systems, streams; additional shallow wells (dug, bored, drive-point) if necessary. On very small islands, catchment of rain water or importation of water may be necessary to augment supplies. Temporary Camp, Field Hospitals:[b] Springs, additional shallow wells (dug, bored, drilled), streams (construction of storage reservoirs may be desirable); on very small islands, catchment of rain water may be necessary to augment supplies. Semipermanent and Permanent Camps, Base Hospitals:[b] Springs, additional shallow wells, streams (storage reservoirs generally necessary); on small islands, catchment of rain water may be necessary to augment supplies.
2a Numerous perennial streams; ground water plentiful, but deep. Upland Plains and Benchlands Gently sloping plains and benchlands, cut by scattered ravines 20 to 200 feet deep. On Samar and Leyte Islands partly cultivated land, coconut groves, and, partly secondary forest and cogon-grass areas. Movement of motorized vehicles generally fairly easy on upland plains, but ravines restrict cross-drainage movement. Few motor roads except in northeast Leyte.	Perennial streams numerous, typically flow in sub-parallel ravines or narrow valleys; generally spaced 2 mile or less apart. Few lakes. Streams have swift current; heavy sediment load of high-water stages. Water is low in dissolved mineral matter; liable to bacteriological pollution.	No known springs. Probably some widely-scattered springs; mainly issue in valleys or near lower borders of areas; majority probably merely seeps, few yielding more than a few gpm. Water more or less hard, but otherwise of good chemical quality; sanitary quality good unless polluted by improper protection at outlet.	Adequate perennial supplies for large troop concentrations; construction of storage reservoirs generally unnecessary except possibly for supplies for large permanent bases. Transport from water points rarely need exceed 3 mile. Steep-sided valleys commonly make streams difficult of access. Treatment problems similar to those in Unit 1a.	Geology: Alluvial fans, underlain by unconsolidated to poorly consolidated gravel, sand and silt, and clay. Locally, hard bedrock (buried hills) may be close to surface. Ground-Water Occurrence: Many gravel and sand beds are moderately permeable, but generally interbedded with large thicknesses of impervious silty and clayey beds. Sandy and gravelly alluvium along streams is highly permeable. Depth to water 50 to 200 feet on interstream uplands; generally less than 30 feet on alluvial flats along streams. Locally, near upper borders of areas, hard bedrock crops out or lies near surface and little or no ground water present. Water in deeper water-bearing sands is under artesian pressure, especially near lower borders of areas. Quality of Water: Water commonly is hard, but otherwise of good chemical quality. In lower parts of areas, however, some aquifers deeper than 200 feet may be saline. Shallow ground water along streams is liable to bacteriological pollution, but the deeper ground water is of excellent sanitary quality.	Very few wells widely scattered on interstream uplands; probably shallow dug wells at many settlements along streams, particularly near borders of Unit 1a. Yields probably only a few gpm, but in many cases could be increased by installation of power pumps and deepening wells a few feet. No known artesian wells.	On alluvial flats along streams, similar to Unit 1a. On interstream uplands, wells must be drilled, 50 to 200 or more feet deep. Yields highly variable from place to place; commonly 6-inch wells will yield 5 to 20 or more gpm. Locally, however, little or no water obtainable. Drilling much faster with rotary rigs than with percussion rigs. In some places, casing needed only in upper part of well. Proper well development after drilling is essential to obtain maximum yield. Water generally sterile without purification.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, streams; existing wells, if present. Temporary Camps, Field Hospitals:[b] Springs, wells, streams. Semipermanent and Permanent Camps, Base Hospitals:[b] Streams, springs, additional drilled wells.
2b Only ephemral streams; ground water plentiful, but deep. Benchlands and Hills Coastal benchlands and low, rugged hills. Movement usually easy on benchlands, locally restricted by ravines; difficult in hills. Fair to good motor roads on benchlands, none in hills.	Only occasional ephemeral streams, flowing after heavy rains. Lanao Lake, on Pacijan Island (Camotes Islands), is only lake; brackish.	Only known spring is at Tubelo (Poro Island). Probably occasional other springs near coast; none in interior. Yields probably only a few gpm; fully utilized by inhabitants.	Generally unsuitable for perennial supplies, although small supplies probably can be developed in places by construction of small reservoirs. Reservoirs commonly will require lining with clay or other impervious material to be watertight. Water should be properly purified for potable supply.	Geology: Underlain mainly by coral limestone, hard but very porous or cavernous; some clayey beds. Ground-Water Occurrence: Coral limestone is mostly highly permeable; occasional clayey beds are impermeable. Water table 50 to 600 feet below surface, depending on topography (shallowest beneath lowlands). Quality of Water: Water is hard. Uppermost, relatively thin layer of ground water is fresh, but beneath the fresh-water layer all deeper ground water is salty. Fresh-water layer is very thin near coast but thickens inland. Sanitary quality probably excellent, except near settlements at margins of areas.	A few shallow wells may be present at settlements near margins of areas. Yields probably are a few gpm; generally supply needs of inhabitants. Water will become brackish if wells are overpumped.	Wells must be 50 to 700 feet deep, depending on topographic location. Fresh-water capacity of wells increases with thickness of fresh-water layer. Therefore, wells should be located as far inland as possible to tap thicker part of fresh-water layer. However, where this layer is thickest, depth to water tends to be relatively great. Wells should not be drilled too deep or overpumped, or water will be contaminated by underlying salty ground water. Near coast, depth should not exceed 1 or 2 feet below sea level; in central parts of islands, can be several feet below sea level. Wells generally must be drilled (rotary rig preferable), although small-capacity dug wells can be constructed in local lowland embayments near coast.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, streams; for large supplies importation of water will be necessary. Temporary Camps, Field Hospitals:[b] Additional wells (also full use of existing wells, springs, not already fully utilized). Semipermanent and Permanent Camps, Base Hospitals:[b] Same as under temporary camps, field hospitals.
3a Surface water plentiful; underground water generally obtainable only locally in stream alluvium. Mountainous or Hilly Areas Mostly rugged, closely-dissected terrain; partly high mountains, partly hill land. Movement generally difficult. Few motor roads.	In interior of Samar and central mountains of Leyte, perennial streams are very numerous. Practically no points (except highest mountains) more than 1 mile from perennial streams. Some moderately large rivers. Perennial streams somewhat less plentiful on other islands and in northwest peninsula of Leyte. Deep narrow valleys. Occasional flash floods; rarely exceed 20 times normal flows. On Pacijan Island on Camotes. A few small lakes on Leyte (see Existing Sources map). Quality of Water: Stream and lake water contains very little dissolved mineral matter (exception: lake Malaksan, near Burauen, acid water). Streams carry heavy sediment loads at high stages. Water commonly liable to bacteriological pollution (should be purified for potable supply) but sanitary quality generally better than in Unit 1.	Springs numerous in some districts, few or none in others. Yields mostly small, rarely more than 50 gpm. Several hot springs southwest of Burauen and elsewhere in central Leyte and on Biliran Island. Most springs do not fluctuate greatly in flow. Quality of Water: Water of most cold springs is hard, otherwise of good chemical quality. Most thermal springs yield more or less mineralized water; those west of Burauen are strongly mineralized and sulfurous.	Movement generally difficult for mobile purification units and motorized troops; small supplies that can be treated with portable purification units or Lister bags probably adequate for expected troop concentrations. Purification by filtering through diatomaceous earth filters or treatment with halazone necessary to insure safe potable supplies.	Geology and Ground-Water Occurrence: Various hard-rock formations, mainly shale, sandstone, lava rock, some limestone, conglomerate, and other rocks. Bedrock largely non-water-bearing, although in a few places moderately to highly permeable zones are within feasible drilling depth. Exact locations of water-bearing zones not known; should be determined from field study by a ground-water geologist. In places along rivers narrow flood plains are underlain by shallow unconsolidated, highly permeable, gravel and sand. Water table in this alluvium is generally within 5 to 40 feet of the surface; ground water generally plentiful, but in places limited. Quality of Water: Water from the alluvium commonly hard, but otherwise generally of excellent chemical quality; is bacteriologically polluted, but in protected or uninhabited areas usually of excellent sanitary quality.	Few, very widely scattered wells. Nearly all are shallow dug wells in local alluvial flats along streams. Water is raised by buckets or hand pumps. Well yields typically only a few gpm. Several abandoned oil-prospect (unsuccessful) wells in northwest peninsula of Leyte.	Plentiful supplies obtainable from shallow unconsolidated gravel deposits underlying local flood plains along streams. Wells 10 to 30 feet deep commonly will yield 10 to several hundred gpm. Dug wells generally most practicable. Terrain is mostly unsuited for movement of well drilling rigs, and deposits are mostly too coarse for drive points, boring or jetting. Installations should be protected from damage by floods. Drilling generally inadvisable in bedrock; relatively few favorable localities, which should be selected by geologist after field study.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, streams, lakes, existing wells. Temporary Camps, Field Hospitals:[b] Springs, additional shallow wells in flood plain alluvium; surface water. Semipermanent Camps, Permanent Camps, Base Hospitals:[b] Additional shallow wells in stream flood plains; springs; surface water if necessary.
3b Little or no surface water or underground water supplies. Miscellaneous Unfavorable Areas Partly mountainous or hilly areas, partly salt-water (mangrove and nipa) swamps. Movement generally very difficult. Almost no roads.	In salt-water swamp areas, no fresh surface water; only brackish sloughs and salty tidal zone near river mouths. In upland areas, streams mainly intermittent or ephemeral brooks, which commonly have appreciable flows in winter rainy season; quality similar to that of streams in Unit 3a.	No springs in salt-water swamp areas. In uplands, springs are widely scattered or absent; very few yield more than 20 gpm. No known thermal springs. Quality of water similar to that of cold springs in Unit 3a.	Perennial supplies not obtainable in many areas. Where streams are small, and on larger islands supplies may be much more readily obtainable in adjacent more favorable areas. On very small islands, catchment of rain water may be feasible. In most upland areas on larger islands, however, small perennial supplies can be obtained by construction of storage reservoirs on main streams; such areas commonly offer numerous good reservoir sites.	Geology and Ground-Water Occurrence: Upland areas are underlain by various hard rocks (see Geology Sheet), largely non-water-bearing. Salt-water swamp areas are underlain by alluvium, mostly clay and silt, some interbedded sand, and coral rock in places. Water table practically at surface, but ground water is saline or brackish. Locally some aquifers at moderate depth may be fresh.	None.	Ground-water supplies generally unobtainable, although in some areas field geological study may disclose sites from which small supplies can be obtained.	Combat, Overnight Bivouac, and Similar Operations:[b] Generally water must be imported; existing wells, cisterns, reservoirs; distillation of sea water. Temporary Camps, Field Hospitals:[b] Supplies insufficient. Semipermanent and Permanent Camps and Base Hospitals:[b] Supplies insufficient.

[a] See Water Supply: Existing Sources Maps for locations of known perennial streams, lakes, springs, and wells.

[b] Sources are listed in order of normal preference.
Approximate daily per capita requirements:
Combat, overnight bivouac, and similar operations, 1 to 4 gallons.
Temporary camp, field hospital, 5 to 40 gallons.
Semipermanent or permanent camp, base hospital, 50 to 200 gallons.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE (P.I.)

MAP UNIT Summary Terrain Features	SURFACE WATER	
	Streams, Canals, Lakes[a]	Springs[a] (gpm = gallons per minute
1a Many closely spaced perennial streams; plentiful shallow ground water. <u>Lowland Plains and Benchlands</u> Coastal plains, beaches, lower benchlands, and river flood plains. Much cultivated land. Principal corridors of movement. Generally easy movement for mobile purification units and well-drilling rigs, although in places swamps, wet paddy fields and unfordable streams restrict movement. Motor roads in many districts.	Perennial streams very numerous and closely spaced. Unit contains lower and middle courses of principal rivers. In many districts, small canals divert water to paddy fields. Fresh-water swamps locally. Very few lakes. Lake Bito, on Bito River, near east coast of Leyte; area 2/5 sq mile, maximum depth 45 feet; surface altitude 10 feet above high tide. <u>Quality of Water</u>: Water contains very little dissolved mineral matter; is soft and generally neutral or slightly acid. Normally most rivers are fresh to their mouths, but at low stages on some rivers brackish water may extend short distances upstream from mouth. At normal stages, water commonly is slightly turbid. Sanitary quality generally poor; water must always be properly purified for potable supply. Swamp water is potable only in emergency, because high organic content causes foul odor and taste, difficult to remove by ordinary purification methods.	Generally sparsely distri ted, but common in some areas. Typically issue base of benchland scarps near inland borders of a a few issure on beaches are inundated at high ti Majority yield only a fe gpm, few yield more than gpm. Springs issuing ne settlements generally ar used for domestic supply and commonly are improve primitive fashion. <u>Quality of Water</u>: Water erally is somewhat harde than surface water, but otherwise of excellent chemical quality. Usual free from bacteriologica pollution if outlet zone properly protected.

[redacted]

Reliability: Fair.

e)	Suggested Methods of Utilization	Geology; Ground-water Occurrence and Quality	UNDERGROUND W Existing Wells[a] (gpm = gallons per
ibu- at or reas; and de. w 50 ar e , d in gen- r ly l is	Transportation from water points rarely need exceed 1 mile, commonly will be much less. Easy terrain for construction of canals, distribution roads, or laying pipe lines. Movement locally restricted by swamps and paddy fields. Supplies adequate for large troop concentrations without construction of storage reservoirs. Many springs will give increased yields by proper improvement. For safe potable supplies, all water from streams and canals should be filtered through diatomaceous earth filters and treated with halazone. During high stream stages, passing water through settling basins will reduce clogging of filters. Spring water locally safe, but commonly requires treatment with halazone.	Geology: River flood plains, deltas, and coastal plains underlain by unconsolidated beds of gravel and sand alternating with beds of silt and clay; in places some coral limestone. Deposits range from a few feet to several hundred feet thick. Ground-Water Occurence: Generally excellent water-bearing sand, gravel, or coral limestone strata at shallow depth. Water table usually within 5 to 40 feet of land surface, shallowest beneath low-laying flats. Abundant artesian water obtainable from deeper strata where deposits are thick, i.e., on outer parts of wide coastal plains, larger river deltas, and on Northeast Leyte plain. Quality of Water: Typically harder than stream water, in places very hard, but otherwise usually of excellent chemical quality. Within 1/4 mile to 1/2 mile of the coast or salt-water estuaries, the shallow ground water is relatively fresh, but deeper water generally is brackish or salty. Many artesian aquifers below 250 feet depth are saline, and below 1,000 feet potable water is rarely encountered. In inhabited areas, shallow ground water commonly is bacteriologically polluted for as much as 25 feet below the water table; water from greater depth usually is free from pathogenic organisms.	Shallow Wells: Majo towns and villages d of all of supply fro dug wells, commonly feet deep, from whic is raised by bucket pump. Yields usuall than 10 gpm, but com be materially increa installing power pum deepening wells a fe Artesian Wells: At Jaro, Ormoc, Naungan Catbalogan, Wright, and Hernani 1 or mor wells furnish part o town water supply. wells range from abo 1,020 feet deep; mos the surface but yiel generally less than free flow; by pumpir ly can be increased times. At Wright, s was found between 59 feet, but was cased 1,025 feet fresh wat encountered, under s pressure to flow at surface.

WATER SUPPLY: GENERAL FEATURES

WATER		RECOMMENDED SOURCES
/ minute)	Location and Construction of Additional Wells	
rity of erive part m shallow 20 to 30 h water or hand y less monly can sed by ps and w feet. Carigara, , Baybay, Villareal, e artesian f the These ut 150 to t flow at ds are 1 gpm by g, common- several alt water 90 and 705 off; at ter was sufficient the	Location: Most favorable areas for development of ground-water supplies. Shallow ground water plentiful, adequate for large troop concentrations. Six-inch drilled wells 30 to 100 feet deep generally will yield from 10 to 100 or more gpm; yields highly variable from place to place; larger diameter dug wells give much greater yields for equivalent depth. Experience in Philippine Islands has shown that about 50% of wells in coral limestone are successful. Wells should be located up-slope and at considerable distance from privies, latrines, garbage pits, and other sources of pollution. Within 1/2-mile of the coast and on small islands, wells should be located as far inland as possible and should not be sunk below layer of fresh ground water into the underlying zone of salty ground water. Pumping should be carefully regulated so that discharge does not become too saline. Drilling: Rate rapid. Rotary drilling rigs preferable, most rapid; percussion rigs also suitable. If drilling rigs unavailable, shallow wells can be constructed in a few hours by drive points, jetting, boring, or digging with pick and shovel. Such methods only practicable on alluvial lowlands where water table is within 20 feet of land surface; require only light equipment. In coral rock, wells generally must be dug or drilled. Casing necessary. Well screens advisable for sand aquifers. After drilling, proper development by surging, heavy pumping, or back-washing will insure maximum well capacity. Water should be chlorinated or treated with halazone, particularly wells supplied by aquifers less than 30 feet below	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, municipal distribution systems, streams, and irrigation canals. Temporary Camp, Field Hospital:[b] Springs, existing wells, or additional shallow wells (drilled, dug, drive point, bored, etc.). Semipermanent or Permanent Camps, Base Hospital:[b] Additional drilled wells, if drilling equipment available, otherwise additional dug, bored, drive point wells; springs.

1b Few or no perennial streams or brackish streams; fresh ground water generally obtainable at depth of a few feet but very limited in some areas. - - <u>Lowland Plains and Benchlands</u> Similar to Unit 1a, except areas typically small, with few or no perennial streams.	On main islands, streams are small brooks, mostly non-perennial, but carry appreciable flows in rainy season. Unit also includes zone of salt-water invasion at mouths of larger rivers. On smaller islands, streams generally flow only after heavy rains. <u>Quality of Water</u>: Water contains very little dissolved mineral matter, except in brackish-water zone at mouths of some rivers and coastal sloughs. Sanitary quality generally poor.	Typically less numerous smaller than in 1a areas otherwise similar to 1a areas.
2a Numerous perennial streams; ground water plentiful, but deep. - - <u>Upland Plains and Benchlands</u> Gently sloping plains and benchlands, cut by scattered ravines 20 to 200 feet deep. On Samar and Leyte Islands partly cultivated land, coconut groves, and, partly secondary forest and cogon-grass areas. Movement of motorized vehicles generally fairly easy on upland plains, but ravines restrict cross-drainage movement. Few motor roads except in northeast Leyte.	Perennial streams numerous, typically flow in sub-parallel ravines or narrow valleys; generally spaced a mile or less apart. Few lakes. Streams have swift current; heavy sediment load of high-water stages. Water is low in dissolved mineral matter; liable to bacteriological pollution.	No known springs. Probab some widely-scattered springs; mainly issue in valleys or near lower bo of areas; majority proba merely seeps, few yield: more than a few gpm. Wa more or less hard, but o wise of good chemical quality; sanitary quali good unless polluted by proper protection at ou
2b Only ephemal streams; ground water plentiful, but deep. <u>Benchlands and Hills</u> Coastal benchlands and low, rugged hills. Movement usually easy on benchlands, locally restricted by ravines; difficult in hills. Fair to good motor roads on benchlands, none in hills.	Only occasional ephemeral streams. flowing after heavy rains. Lanao Lake, on Pacijan Island (Camotes Islands), is only lake; brackish.	Only known spring is at Tudela (Poro Island). P ably occasional other springs near coast; non interior. Yields proba only a few gpm; fully u lized by inhabitants.

and ;	Widely scattered sources may entail relatively long transport from water points. Construction of storage reservoirs commonly is necessary to insure perennial supplies from streams. Best reservoir sites generally are narrow valleys in Units 2 or 3. Water should be properly purified.	Similar to 1a. Alluvial deposits commonly are shallow, and in some places contain only limited quantities of ground water.	Shallow dug wells at settlements; usually only a few gpm. No artesian wells. Pro some wells near shor are brackish.
bly n orders ably ing ter other ty im- tlet.	Adequate perennial supplies for large troop concentrations; construction of storage reservoirs generally unnecessary except possibly for supplies for large permanent bases. Transport from water points rarely need exceed 1 mile. Steep-sided valleys commonly make streams difficult of access. Treatment problems similar to those in Unit 1a.	Geology: Alluvial fans, underlain by unconsolidated to poorly consolidated gravel, sand and silt, and clay. Locally, hard bedrock (buried hills) may be close to surface. Ground-Water Occurrence: Many gravel and sand beds are moderately permeable, but generally interbedded with large thicknesses of impervious silty and clayey beds. Sandy and gravelly alluvium along streams is highly permeable. Depth to water 50 to 200 feet on interstream uplands; generally less than 30 feet on alluvial flats along streams. Locally, near upper borders of areas, hard bedrock crops out or lies near surface and little or no ground water present. Water in deeper water-bearing sands is under artesian pressure, especially near lower borders of areas. Quality of Water: Water commonly is hard, but otherwise of good chemical quality. In lower parts of areas, however, some aquifers deeper than 200 feet may be saline. Shallow ground water along streams is liable to bacteriological pollution, but the deeper ground water is of excellent sanitary quality.	Very few wells wide scattered on inters uplands; probably s dug wells at many s ments along streams cularly near border 1a. Yields probabl few gpm, but in ma could be increased stallation of power and deepening wells feet. No known art wells.
rob- e in bly ti-	Generally unsuitable for perennial supplies, although small supplies probably can be developed in places by construction of small reservoirs. Reservoirs commonly will require lining with clay or other impervious material to be watertight. Water should be properly purified for potable supply.	Geology: Underlain mainly by coral limestone, hard but very porous or cavernous; some clayey beds. Ground-Water Occurrence: Coral limestone is mostly highly permeable; occasional clayey beds are impermeable. Water table 50 to 600 feet below surface, depending on topography (shallowest beneath lowlands). Quality of Water: Water is hard. Uppermost, relatively thin layer of ground water is fresh, but beneath the fresh-water layer all deeper ground water is salty. Fresh-water layer is very thin near coast but thickens inland. Sanitary quality probably excellent, except near settlements at margins of area.	A few shallow wells present at settleme margins of areas. probably are a few barely supply needs habitants. Water come brackish if we overpumped. overpumped, or wa water. Near coas in central parts generally must be acity dug wells

t most y yield known obably reline	water table. If wells tap deeper aquifers and shallow aquifers are properly sealed off, water probably will be sterile.	
	Same as 1a, except typically only small supplies obtainable.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, municipal distribution systems, streams; additional shallow wells (dug, bored, drivepoint) if necessary. On very small islands, catchment of rain water or importation of water may be necessary to augment supplies. Temporary Camp, Field Hospital:[b] Springs, additional shallow wells (dug, bored, drilled), streams (construction of storage reservoirs may be desirable); on very small islands, catchment of rain water may be necessary to augment supplies. Semipermanent and Permanent Camps, Base Hospitals:[b] Springs, additional shallow wells, streams (storage reservoirs generally necessary); on small islands, catchment of rain water may be necessary to augment supplies.
ly tream hallow ettle- , parti- s of Unit y only a ny cases by in- pumps a few esian	On alluvial flats along streams, similar to Unit 1a. On interstream uplands, wells must be drilled, 50 to 200 or more feet deep. Yields highly variable from place to place; commonly 6-inch wells will yield 5 to 20 or more gpm. Locally, however, little or no water obtainable. Drilling much faster with rotary rigs than with percussion rigs. In some places, casing needed only in upper part of well. Proper well development after drilling is essential to obtain maximum yield. Water generally sterile without purification.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, streams; existing wells, if present. Temporary Camps, Field Hospitals:[b] Springs, wells, streams. Semipermanent and Permanent Camps, Base Hospitals:[b] Streams, springs, additional drilled wells.
s may be ents near Yields gpm; s of in- will be- ells are	Wells must be 50 to 700 feet deep, depending on topographic location. Fresh-water capacity of wells increases with thickness of fresh-water layer. Therefore, wells should be located as far inland as possible to tap thicker part of fresh-water layer. However, where this layer is thickest, depth to water tends to be relatively great. Wells should not be drilled too deep or ater will be contaminated by underlying salty ground st, depth should not exceed 1 or 2 feet below sea level; of islands, can be several feet below sea level. Wells e drilled (rotary rig preferable), although small-cap- can be constructed in local lowland embayments near coast.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, existing wells, streams; for large supplies importation of water will be necessary. Temporary Camps, Field Hospitals:[b] Additional wells (also full use of existing wells, springs, not already fully utilized). Semipermanent and Permanent Camps, Base Hospitals:[b] Same as under temporary camps, field hospitals.

3a Surface water plentiful; underground water generally obtainable only locally in stream alluvium. - - Mountainous or Hilly Areas Mostly rugged, closely-dissected terrain; partly high mountains, partly hill land Movement generally difficult. Few motor roads.	In interior of Samar and central mountains of Leyte, perennial streams are very numerous. Practically no points (except highest mountains) more than 1 mile from perennial streams. Some moderately large rivers. Perennial streams somewhat less plentiful on other islands and in northwest peninsula of Leyte. Deep narrow valleys. Occasional flash floods; rarely exceed 20 times normal flows. No lakes known on Samar. A few small lakes on Leyte (see Existing Sources map). Quality of Water: Stream and lake water contains very little dissolved mineral matter (exception: Lake Malaksan, near Burauen, acid water). Streams carry heavy sediment loads at high stages. Water commonly liable to bacteriological p tion (should be purified for potable supply) but sanitary quality generally better than in Unit 1.	Springs numerous in so districts, few or none others. Yields mostly small, rarely more tha 50 gpm. Several hot springs southwest of Buaruen and elsewhere central Leyte and on B Island. Most springs fluctuate greatly in f Quality of Water: Wat most cold springs is h otherwise of good chem quality. Most thermal springs yield more or west of Burauen are st
3b Little or no surface water or underground water supplies. - - Miscellaneous Unfavorable Areas Partly mountainous or hilly areas, partly salt-water (mangrove and nipa) swamps. Movement generally very difficult. Almost no roads.	In salt-water swamp areas, no fresh surface water; only brackish sloughs and salty tidal zone near river mouths. In upland areas, streams mainly intermittent or ephemeral brooks, which commonly have appreciable flows in winter rainy season; quality similar to that of streams in Unit 3a.	No springs in salt-wat swamp areas. In uplan springs are widely sca ed or absent; very few yield more than 20 gpm No known thermal sprin Quality of water simil to that of cold spring Unit 3a.

ne in n in iliran do not low. er of ard, ical	Movement generally difficult for mobile purification units and motorized troops; small supplies that can be treated with portable purification units or Lister bags probably adequate for expected troop concentrations. Purification by filtering through diatomaceous earth filters or treatment with halazone necessary to insure safe potable supplies.	Geology and Ground-Water Occurrence: Various hard-rock formations, mainly shale, sandstone, lava rock, some limestone, conglomerate, and other rocks. Bedrock largely non-water-bearing, although in a few places moderately to highly permeable zones are within feasible drilling depth. Exact locations of water-bearing zones not known; should be determined from field study by a ground-water geologist. In places along rivers narrow flood plains are underlain by shallow unconsolidated, highly permeable, gravel and sand. Water table in this alluvium is generally within 5 to 20 feet of the surface; ground water generally plentif but in places limited. Quality of Water: Water from the alluvium commonly hard, but othe wise generally of excellent chemical quality; is readily liable to bacteriologic pollution, but in protected or uninhabited areas usually of excellent sanitary quality.	Few, very widely s wells. Nearly all shallow dug wells alluvial flats alo streams. Water is buckets or hand pu yields typically o gpm. Several aban prospect (unsucces in northwest penin Leyte.
less mineralized water; those rongly mineralized and sulfurous.			
ollu-			
er ds, tter- . gs. ar s in	Perennial supplies not obtainable in many areas. Majority of areas are small, and on larger islands supplies may be much more readily obtainable in adjacent more favorable areas. On very small islands, catchment of rain water may be feasible. In most upland areas on larger islands, however, small perennial supplies can be obtained by construction of storage reservoirs on main streams; such areas commonly offer numerous good reservoir sites.	Geology and Ground-Water Occurrence: Upland areas are underlain by various hard rocks (see Geology Sheet), largely non-water-bearing. Salt-water swamp areas are underlain by alluvium, mostly clay and silt, some interbedded sand, and coral rock in places. Water table practically at surface, but ground water is saline or brackish. Locally some aquifers at moderate depth may be fresh.	None.

a/ See Water Supply: Existing Sources Maps for locations of known perennial streams, lakes, springs, and wells.

b/ Sources are listed in order of normal preference.
Approximate daily per capita requirements:
Combat, overnight bivouac, and similar operations, 1 to 4 gallons.
Temporary camp, field hospital, 5 to 40 gallons.
Semipermanent or permanent camp, base hospital, 50 to 200 gallons.

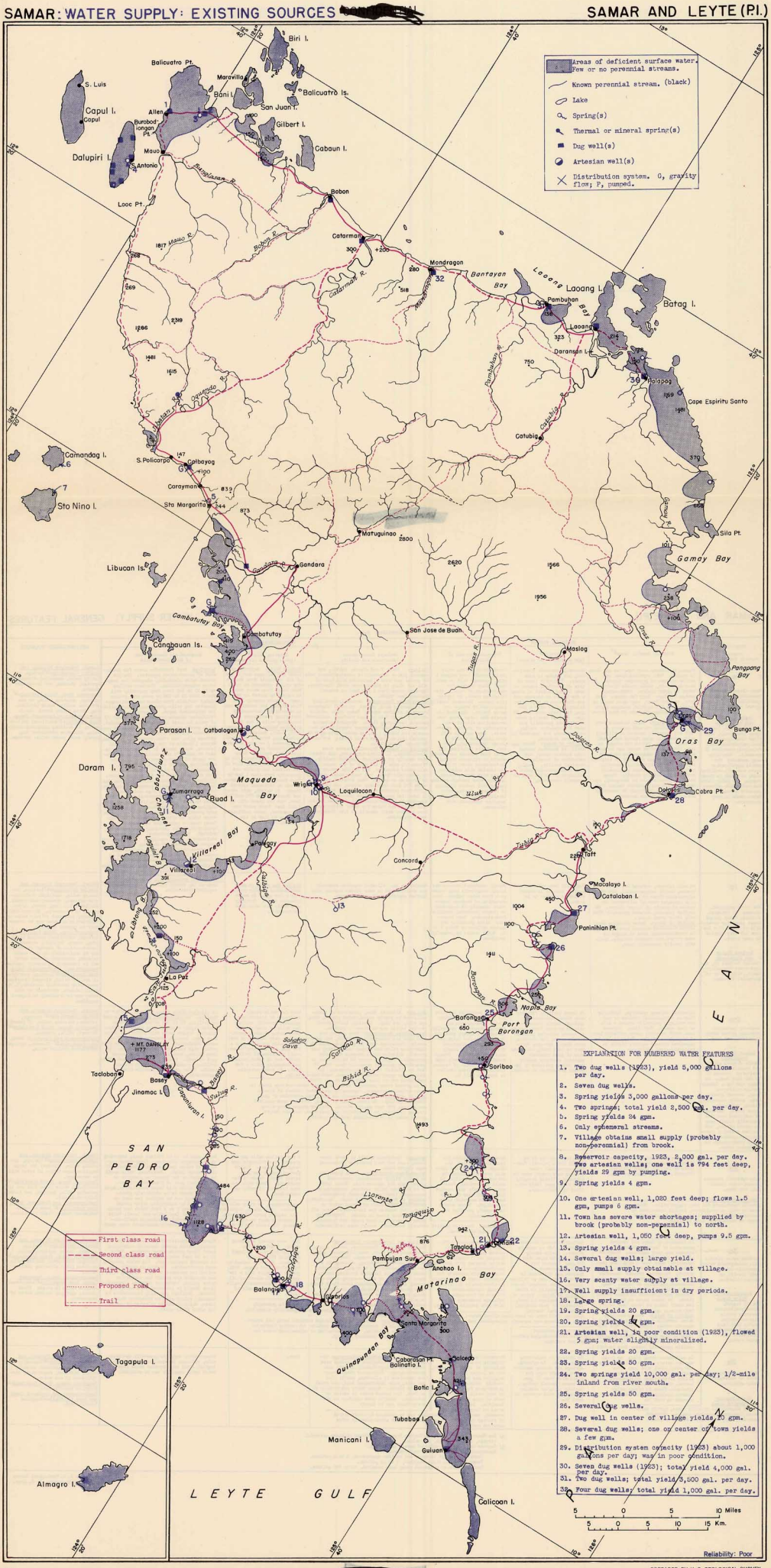
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cattered are in local ng raised by mps. Well nly a few doned oil- sful) wells sula of — ul, r-	Plentiful supplies obtainable from shallow unconsolidated gravel deposits underlying local flood plains along streams. Wells 10 to 30 feet deep commonly will yield 10 to several hundred gpm. Dug wells generally most practicable. Terrain is mostly unsuited for movement of well drilling rigs, and deposits are mostly too coarse for drive points, boring or jetting. Installations should be protected from damage by floods. Drilling generally inadvisable in bedrock; relatively few favorable localities, which should be selected by geologist after field study.	Combat, Overnight Bivouac, and Similar Operations:[b] Springs, streams, lakes, existing wells. Temporary Camps, Field Hospitals:[b] Springs, additional shallow wells in flood plain alluvium; surface water. Semipermanent Camps, Permanent Camps, Base Hospitals:[b] Additional shallow wells in stream flood plains; springs; surface water if necessary.
	Ground-water supplies generally unobtainable, although in some areas field geological study may disclose sites from which small supplies can be obtained.	Combat, Overnight Bivouac, and Similar Operations:[b] Generally water must be imported; existing wells, cisterns, reservoirs; distillation of sea water. Temporary Camps, Field Hospitals:[b] Supplies insufficient. Semipermanent and Permanent Camps and Base Hospitals:[b] Supplies insufficient.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR: WATER SUPPLY: EXISTING SOURCES [redacted]

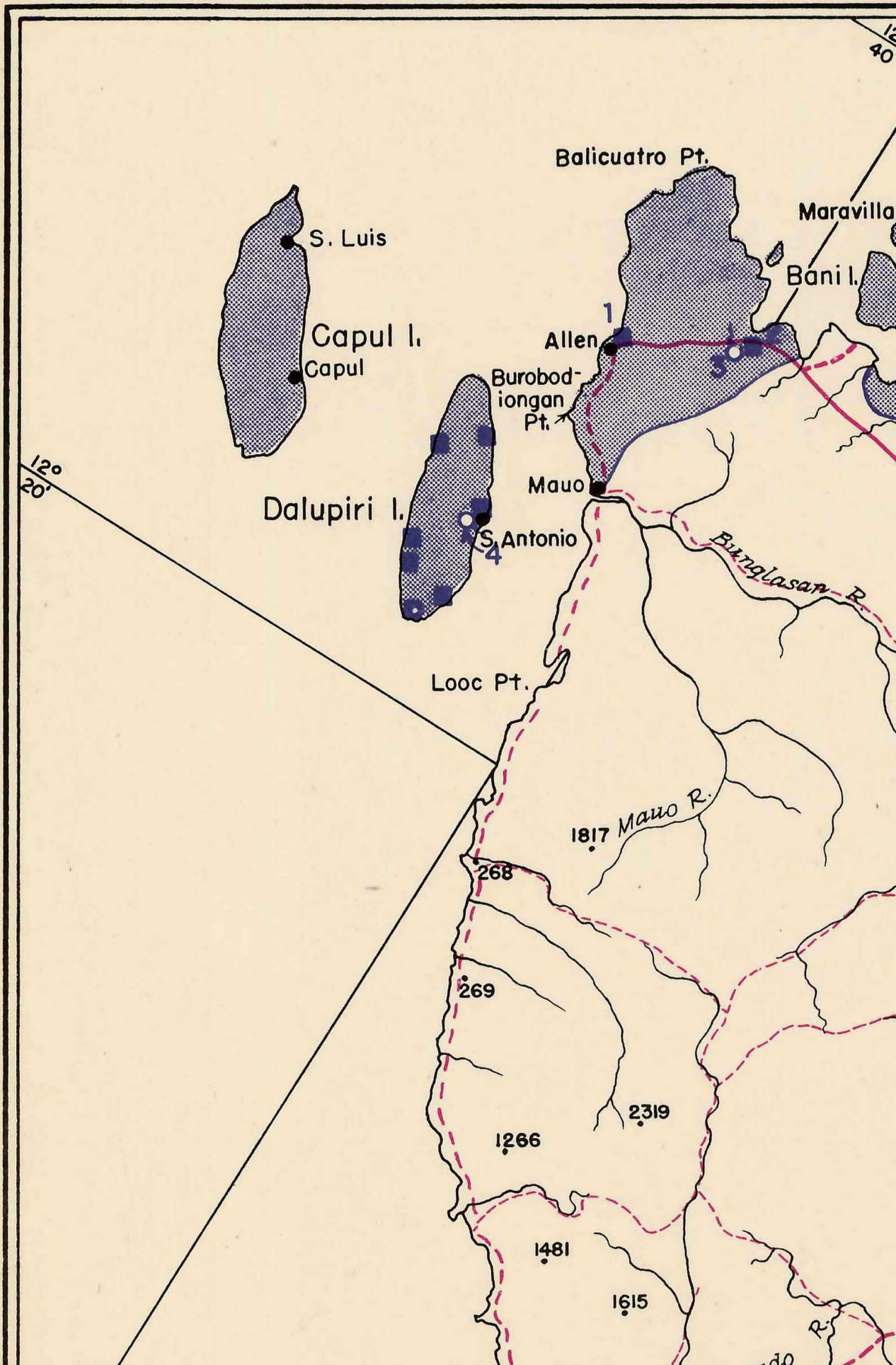
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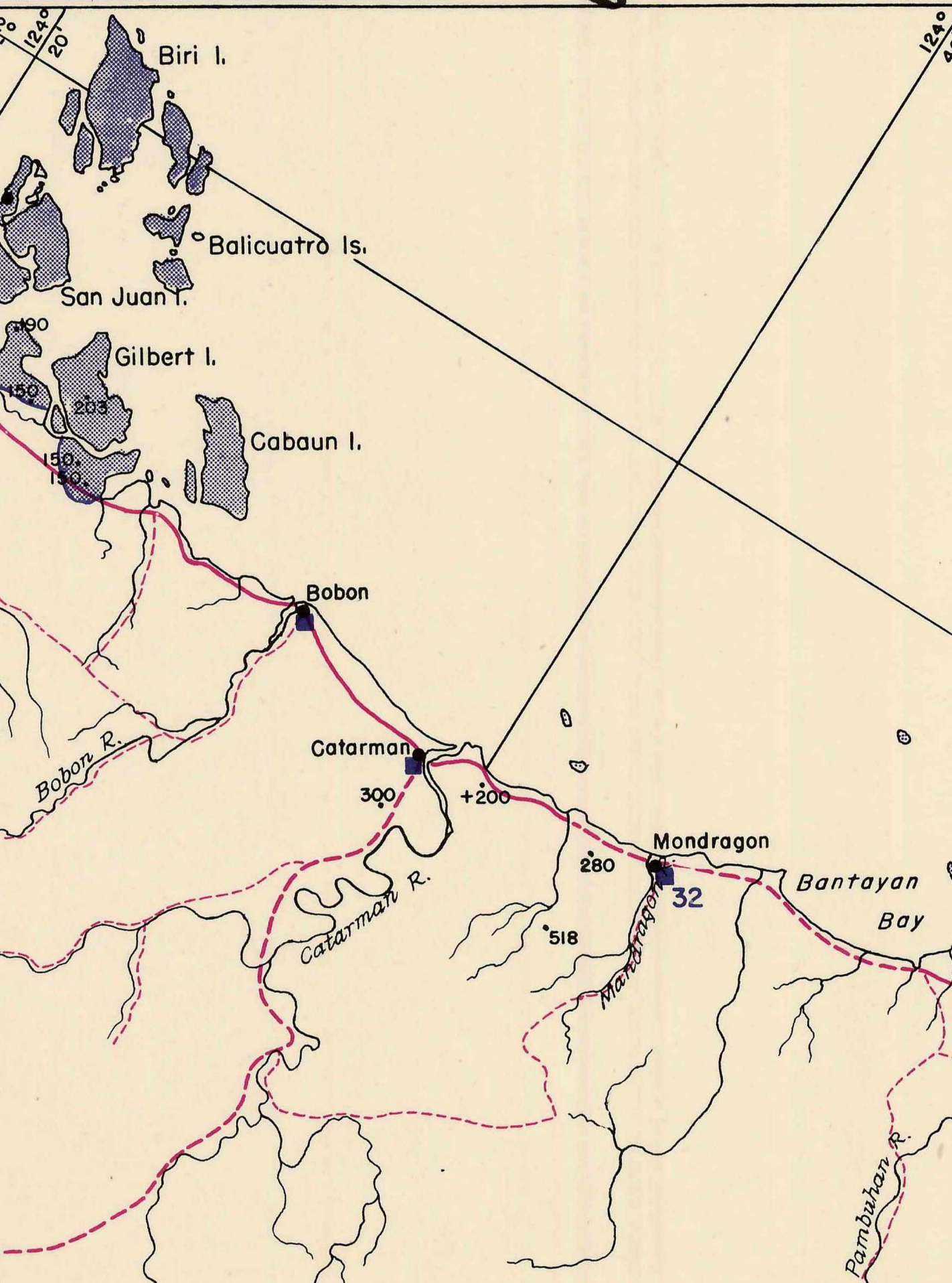


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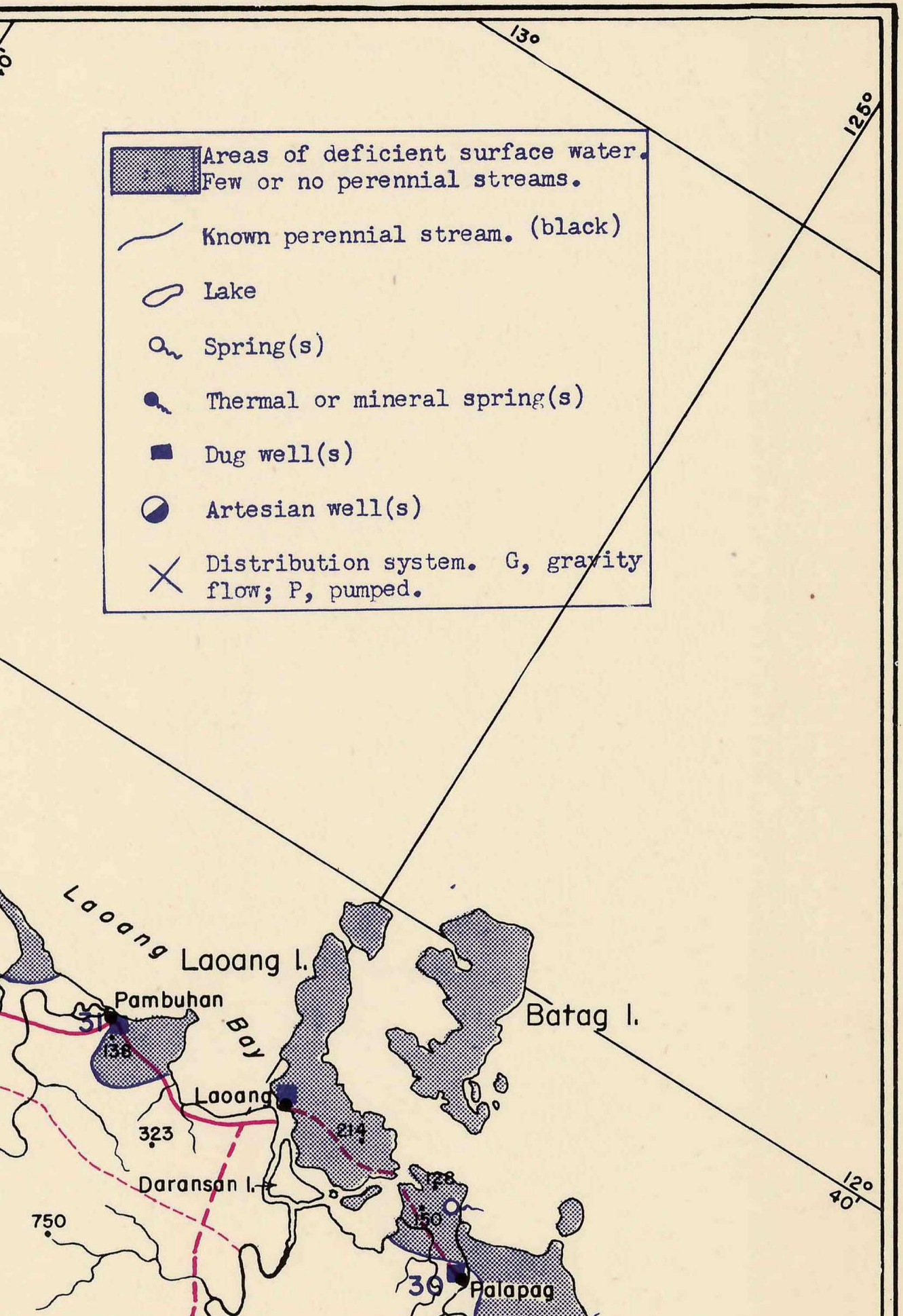
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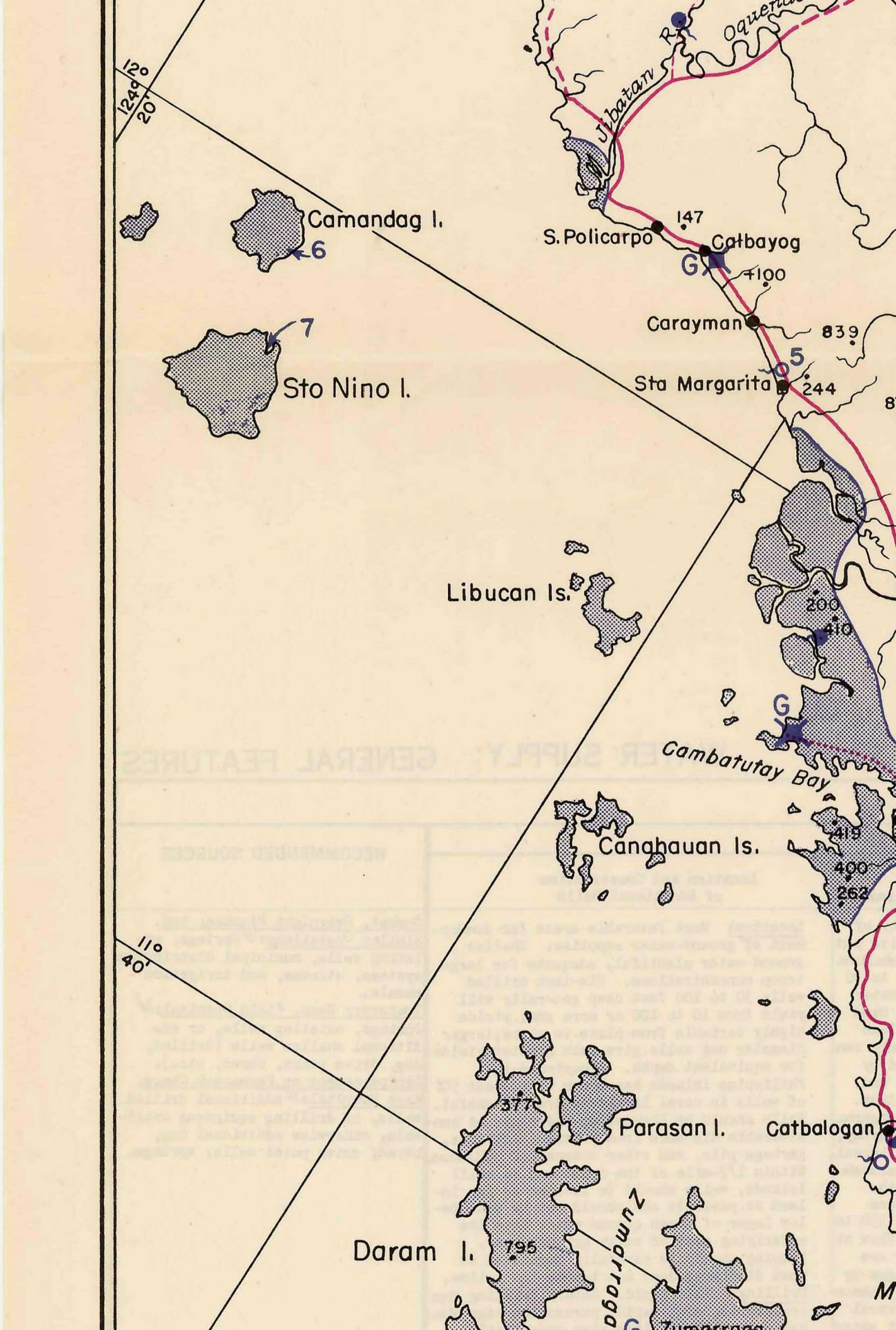
SAMAR: WATER SUPPLY: EXISTI

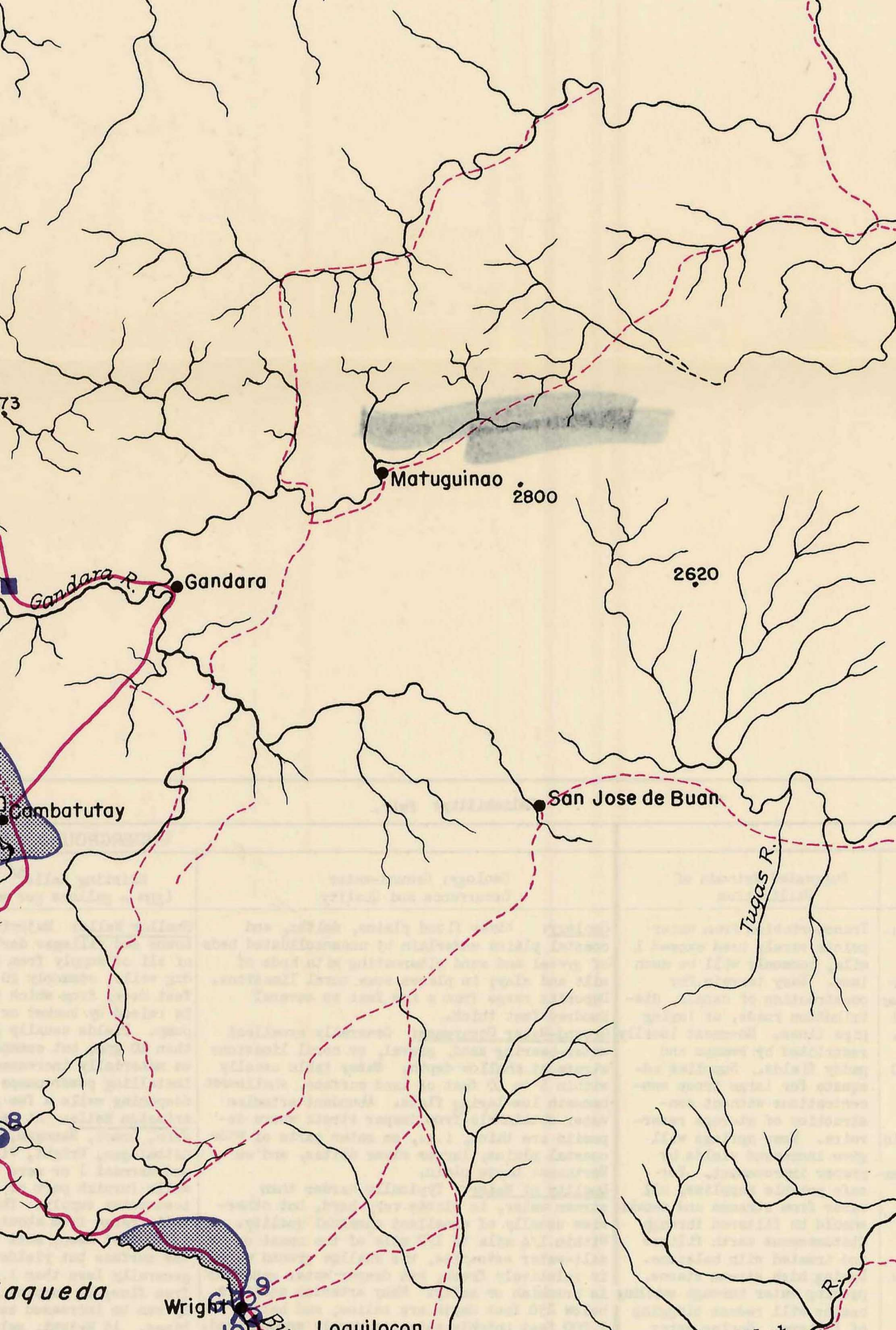


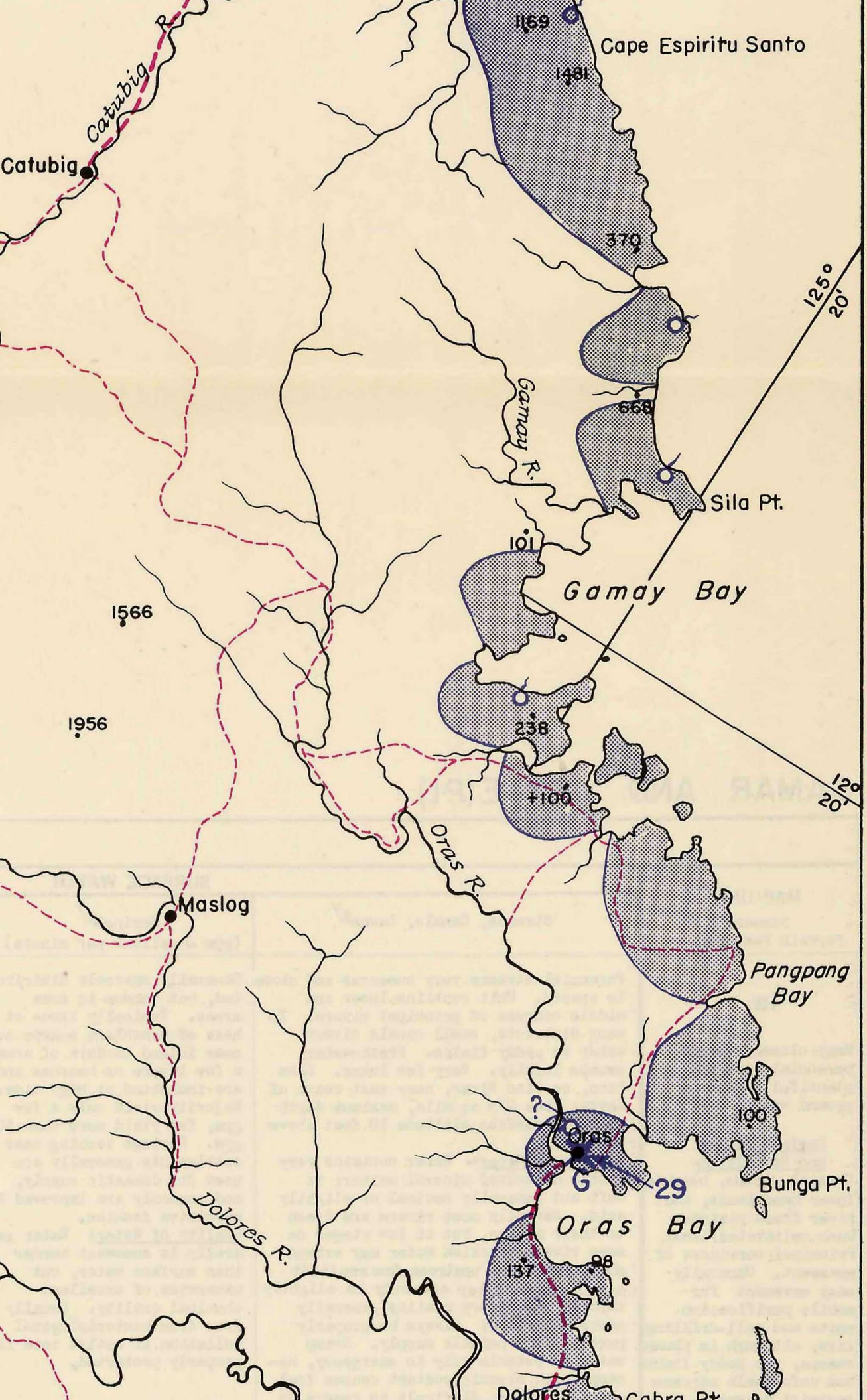

Biri I.
Balicuatro Is.
San Juan I.
Gilbert I.
Cabaun I.
190
150
203
150
150
Bobon
Bobon R.
Catarman
300
+200
Catarman R.
Mondragon
280
32
518
Mandangan
Bantayan
Bay
Pambuhan R.

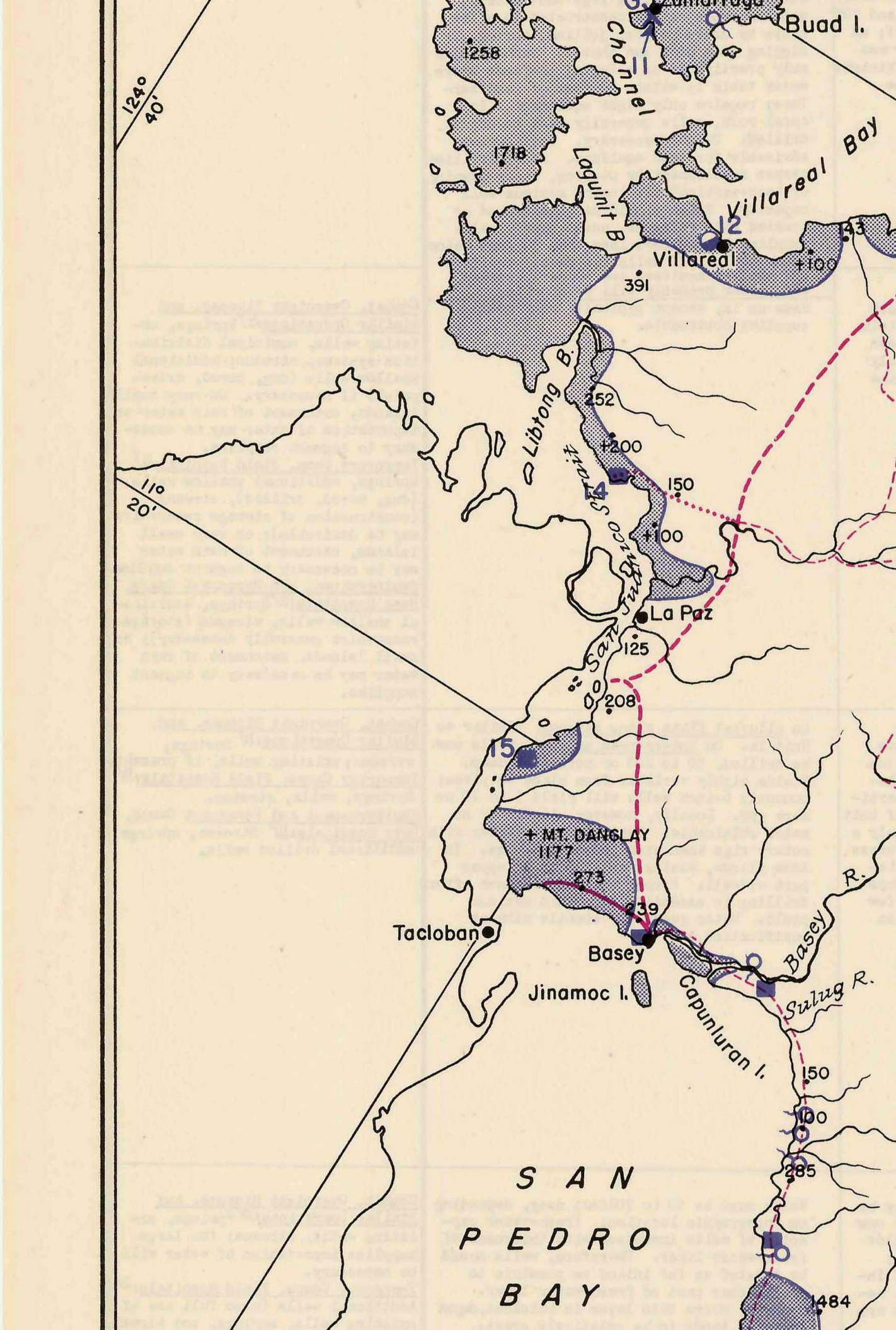
SAMAR AND LEYTE (P.I.)

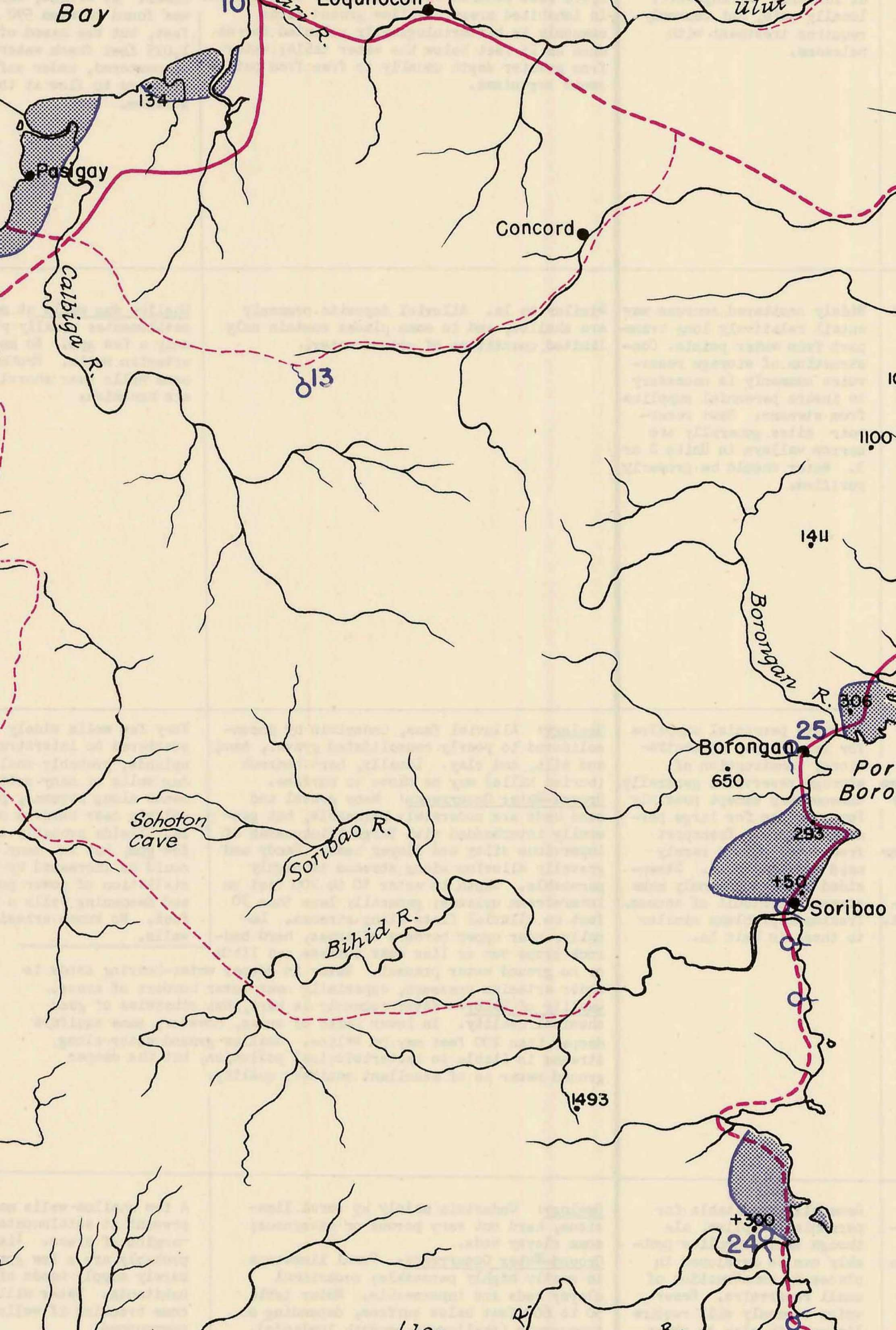


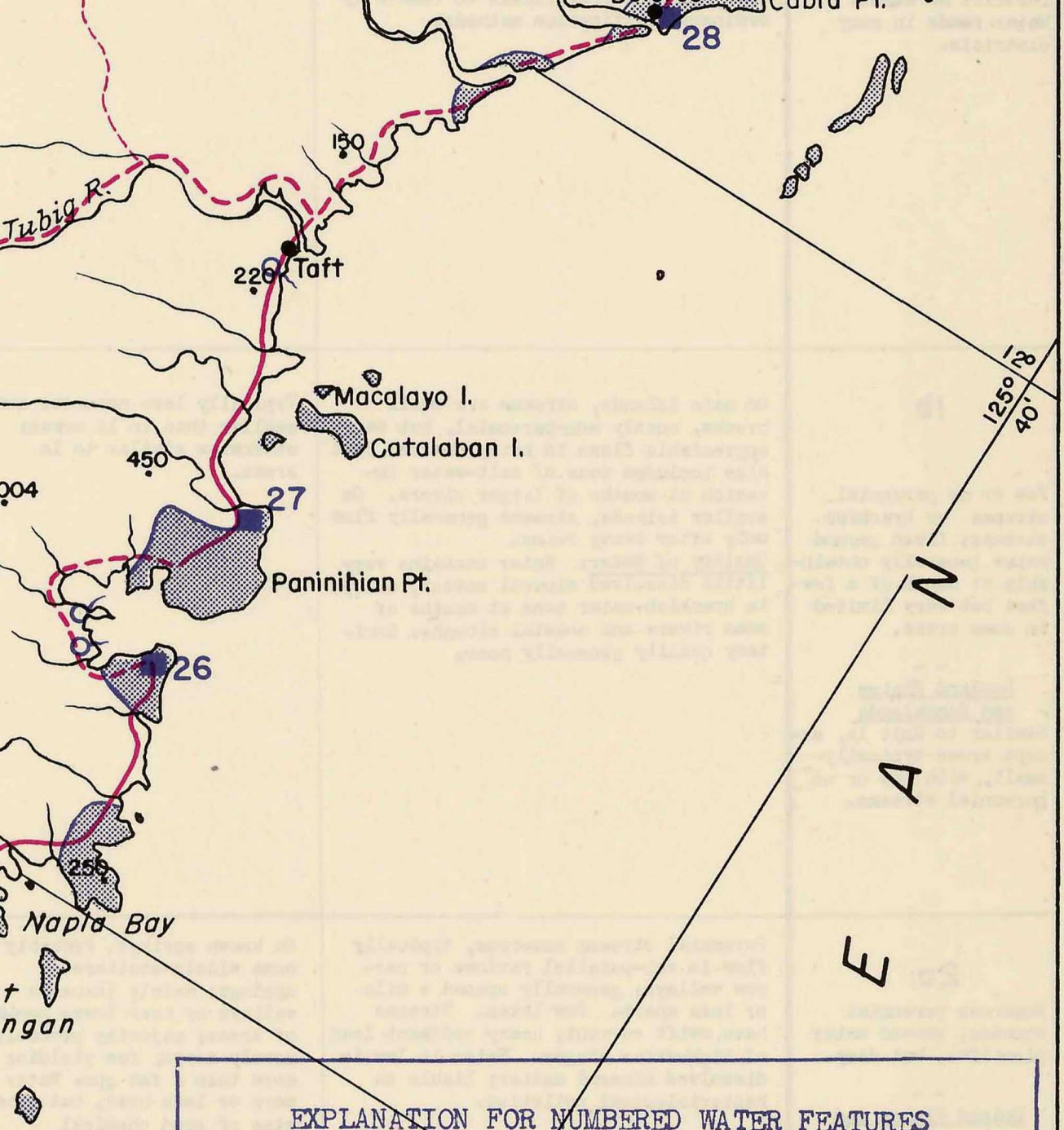

Jibatan R.
Oquendo
120
20'
124°
Camandag I.
6
S. Policarpo
147
Catbayog
G
+100
Carayman
839
7
Sto Nino I.
5
Sta Margarita
244
Libucan Is.
200
410
G
Cambatutay Bay
Canahauan Is.
419
400
262
110
40'
377
Parasan I.
Catbalogan
Daram I.
795
Zumarraga


73
Matuguinao
2800
2620
Gandara R.
Gandara
Cambatutay
San Jose de Buan
Tugas R.
aqueda
Wright
Loquilocon


Catubig R.
Catubig
1169
Cape Espiritu Santo
1491
379
125° 20'
Gamay R.
668
Sila Pt.
101
Gamay Bay
1566
1956
238
+100
12° 20'
Oras R.
Maslog
Pangpang Bay
100
?
Oras
G
29
Bunga Pt.
Oras Bay
137
98
Dolores R.
Dolores
Cabra Pt.

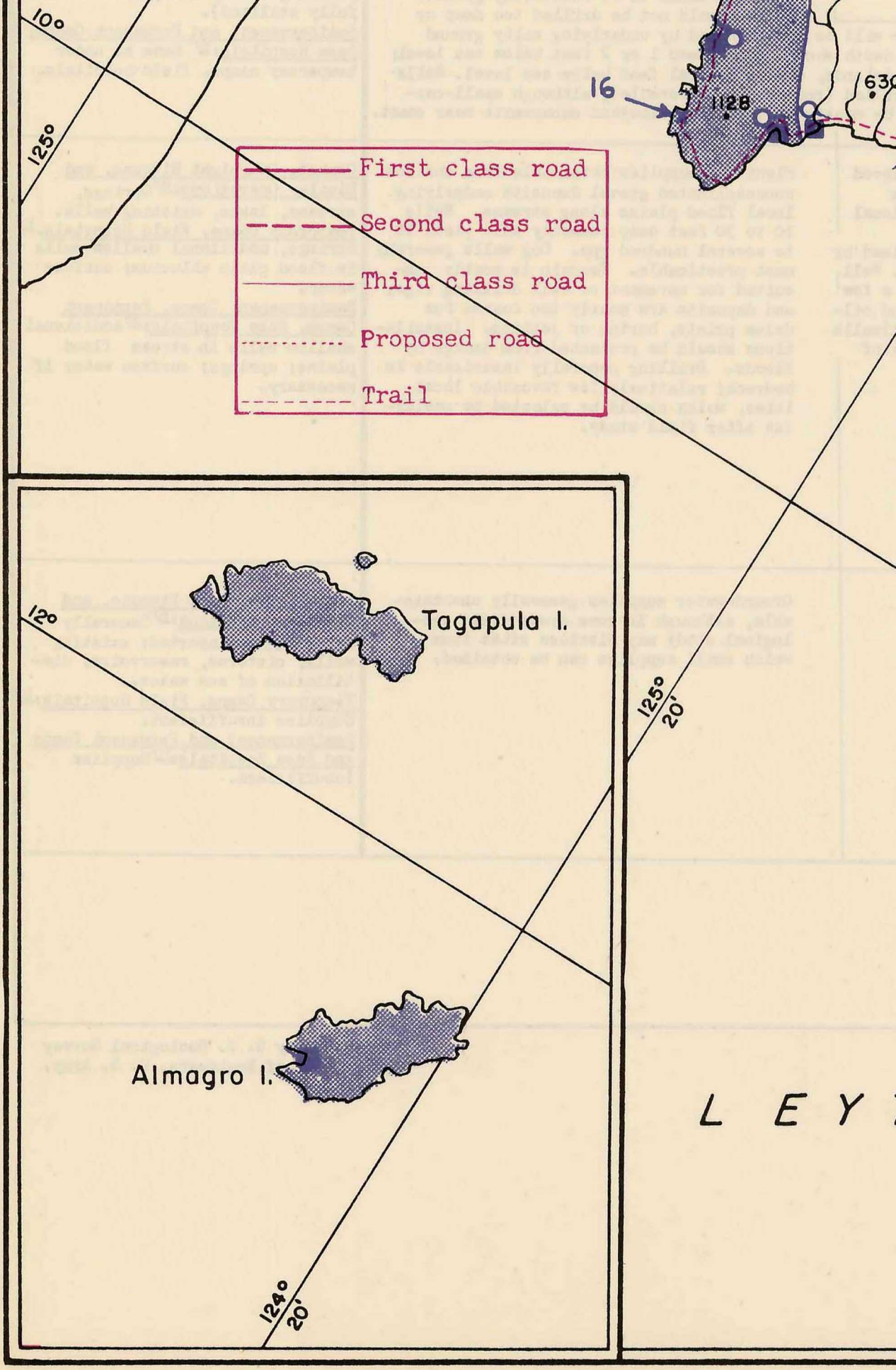

124° 40'
110° 20'
Buad I.
Channel
1258
1718
Laguinit B.
Villareal Bay
Villareal
+100
391
Libtong B.
252
+200
Strait
150
+100
La Paz
125
San Juanico
208
+ MT. DANGLAY
1177
273
239
Tacloban
Basey
Basey R.
Jinamoc I.
Capunluran I.
Suluug R.
150
100
285
SAN
PEDRO
BAY
1484

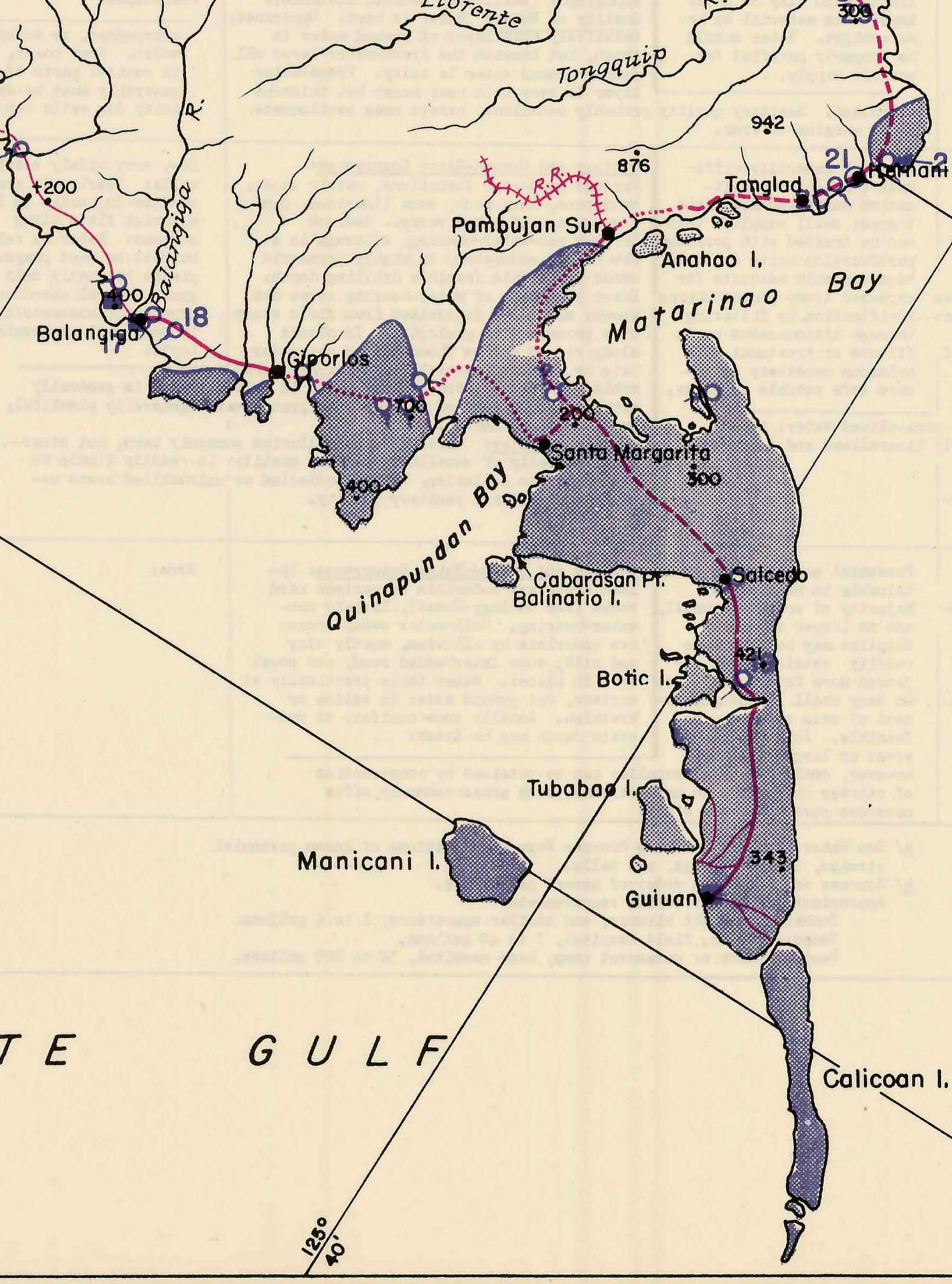

Bay
10
Loquilocon
Ulut
134
Pasigay
Concord
Calbiga R.
13
1100
141
Borongan R.
306
25
Borongan
650
Por
Boro
293
150
Soribao
Sohoton
Cave
Soribao R.
Bihid R.
1493
+300
24



EXPLANATION FOR NUMBERED WATER FEATURES

1. Two dug wells (1923), yield 5,000 gallons per day.
2. Seven dug wells.
3. Spring yields 3,000 gallons per day.
4. Two springs; total yield 2,500 gal. per day.
5. Spring yields 24 gpm.
6. Only ephemeral streams.
7. Village obtains small supply (probably non-perennial) from brook.
8. Reservoir capacity, 1923, 2,000 gal. per day. Two artesian wells; one well is 794 feet deep, yields 29 gpm by pumping.
9. Spring yields 4 gpm.


100
125°
16
1128
630
First class road
Second class road
Third class road
Proposed road
Trail
120
Tagapula I.
125° 20'
Almagro I.
124° 20'
L E Y



CONFIDENTIAL

10. One artesian well, 1,020 feet deep; flows 1.5 gpm, pumps 6 gpm.
11. Town has severe water shortages; supplied by brook (probably non-perennial) to north.
12. Artesian well, 1,050 feet deep, pumps 9.5 gpm.
13. Spring yields 4 gpm.
14. Several dug wells; large yield.
15. Only small supply obtainable at village.
16. Very scanty water supply at village.
17. Well supply insufficient in dry periods.
18. Large spring.
19. Spring yields 20 gpm.
20. Spring yields 25 gpm.
21. Artesian well, in poor condition (1923), flowed 5 gpm; water slightly mineralized.
22. Spring yields 20 gpm.
23. Spring yields 50 gpm.
24. Two springs yield 10,000 gal. per day; 1/2-mile inland from river mouth.
25. Spring yields 50 gpm.
26. Several dug wells.
27. Dug well in center of village yields 10 gpm.
28. Several dug wells; one on center of town yields a few gpm.
29. Distribution system capacity (1923) about 1,000 gallons per day; was in poor condition.
30. Seven dug wells (1923); total yield 4,000 gal. per day.
31. Two dug wells; total yield 3,500 gal. per day.
32. Four dug wells; total yield 1,000 gal. per day.

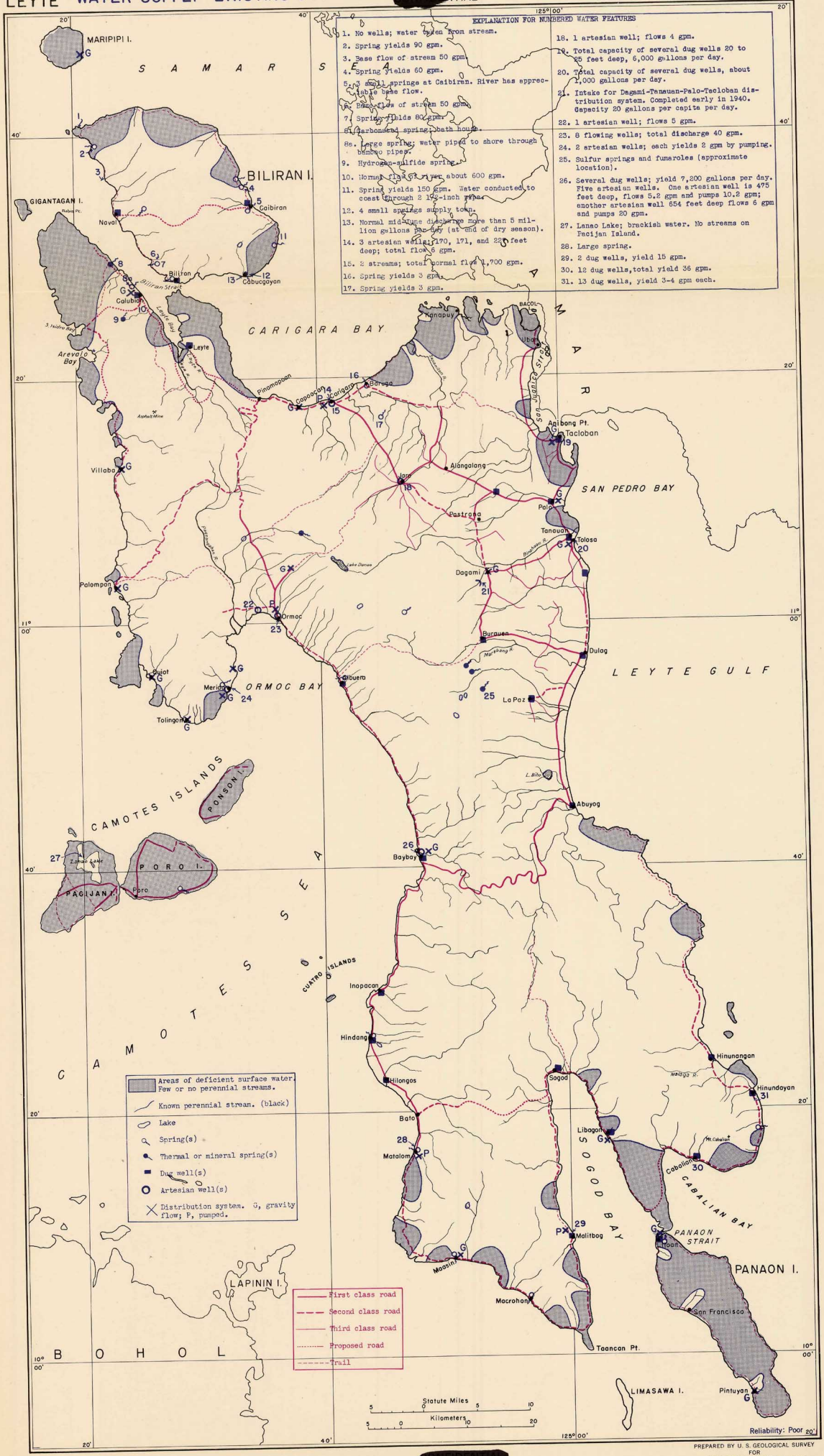
5 0 5 10 Miles

5 0 5 10 15 Km.

Reliability: Poor

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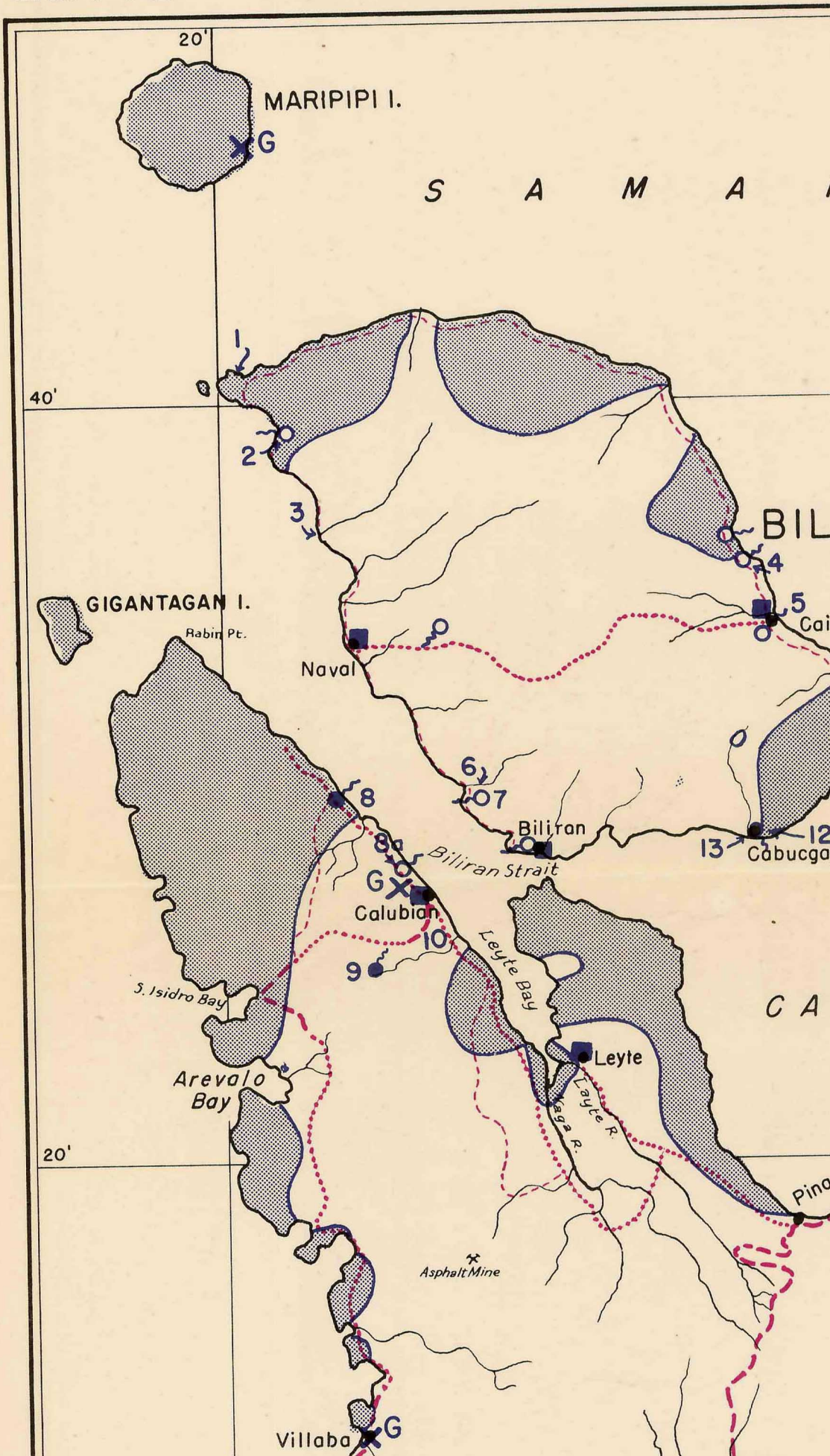
LEYTE WATER SUPPLY: EXISTING SOURCES [redacted] SAMAR AND LEYTE (P.I.)



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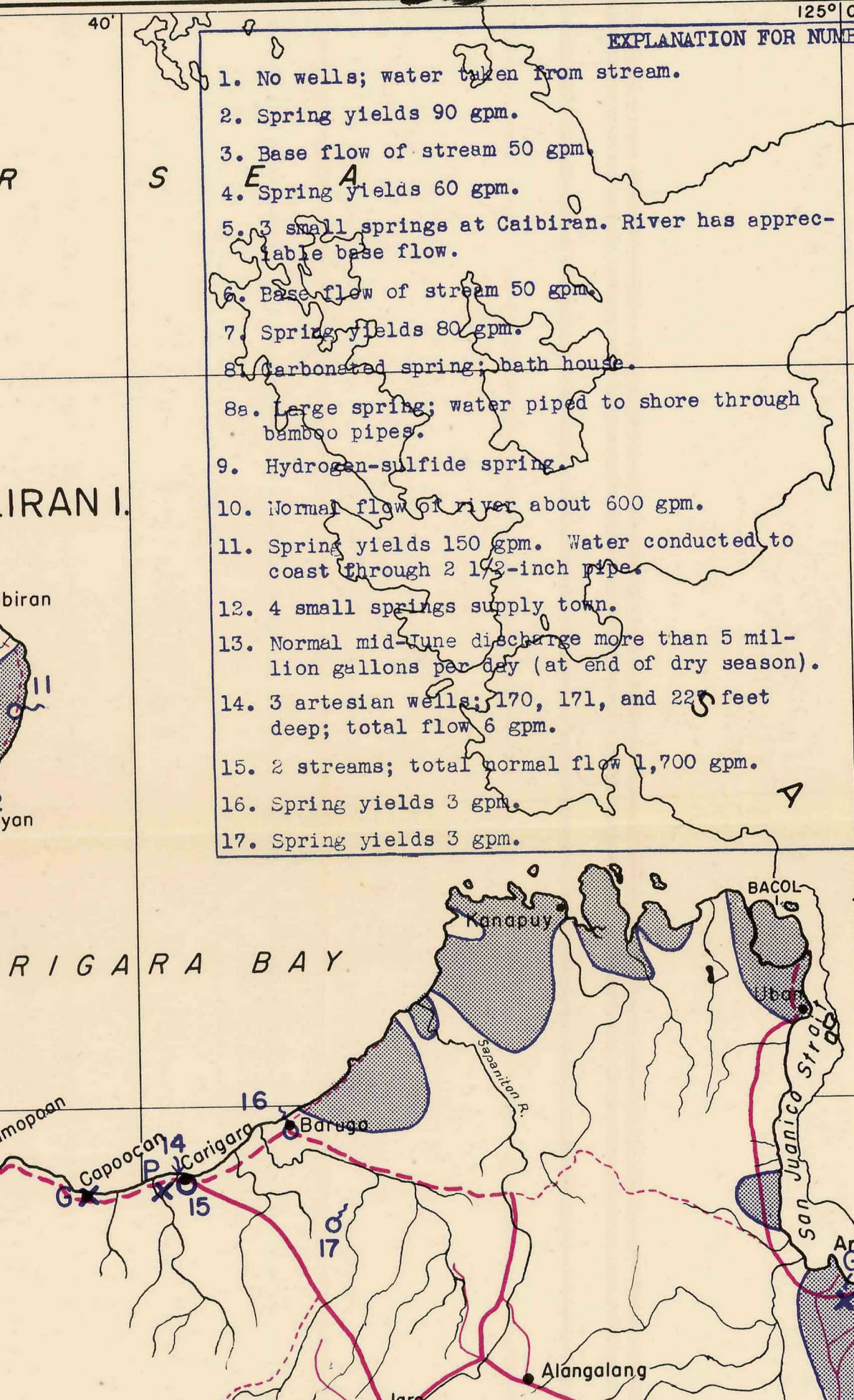
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LEYTE WATER SUPPLY: EXISTI



NG SOURCES

CONFIDENTIAL



SAMAR AND LEYTE (P.I.)

00' 20'

BERED WATER FEATURES

18. 1 artesian well; flows 4 gpm.

19. Total capacity of several dug wells 20 to 25 feet deep, 6,000 gallons per day.

20. Total capacity of several dug wells, about 1,000 gallons per day.

21. Intake for Dagami-Tanauan-Palo-Tacloban distribution system. Completed early in 1940. Capacity 20 gallons per capita per day.

22. 1 artesian well; flows 5 gpm.

40'

23. 8 flowing wells; total discharge 40 gpm.

24. 2 artesian wells; each yields 2 gpm by pumping.

25. Sulfur springs and fumaroles (approximate location).

26. Several dug wells; yield 7,200 gallons per day. Five artesian wells. One artesian well is 475 feet deep, flows 5.2 gpm and pumps 10.2 gpm; another artesian well 654 feet deep flows 6 gpm and pumps 20 gpm.

27. Lanao Lake; brackish water. No streams on Pacijan Island.

28. Large spring.

29. 2 dug wells, yield 15 gpm.

30. 12 dug wells, total yield 36 gpm.

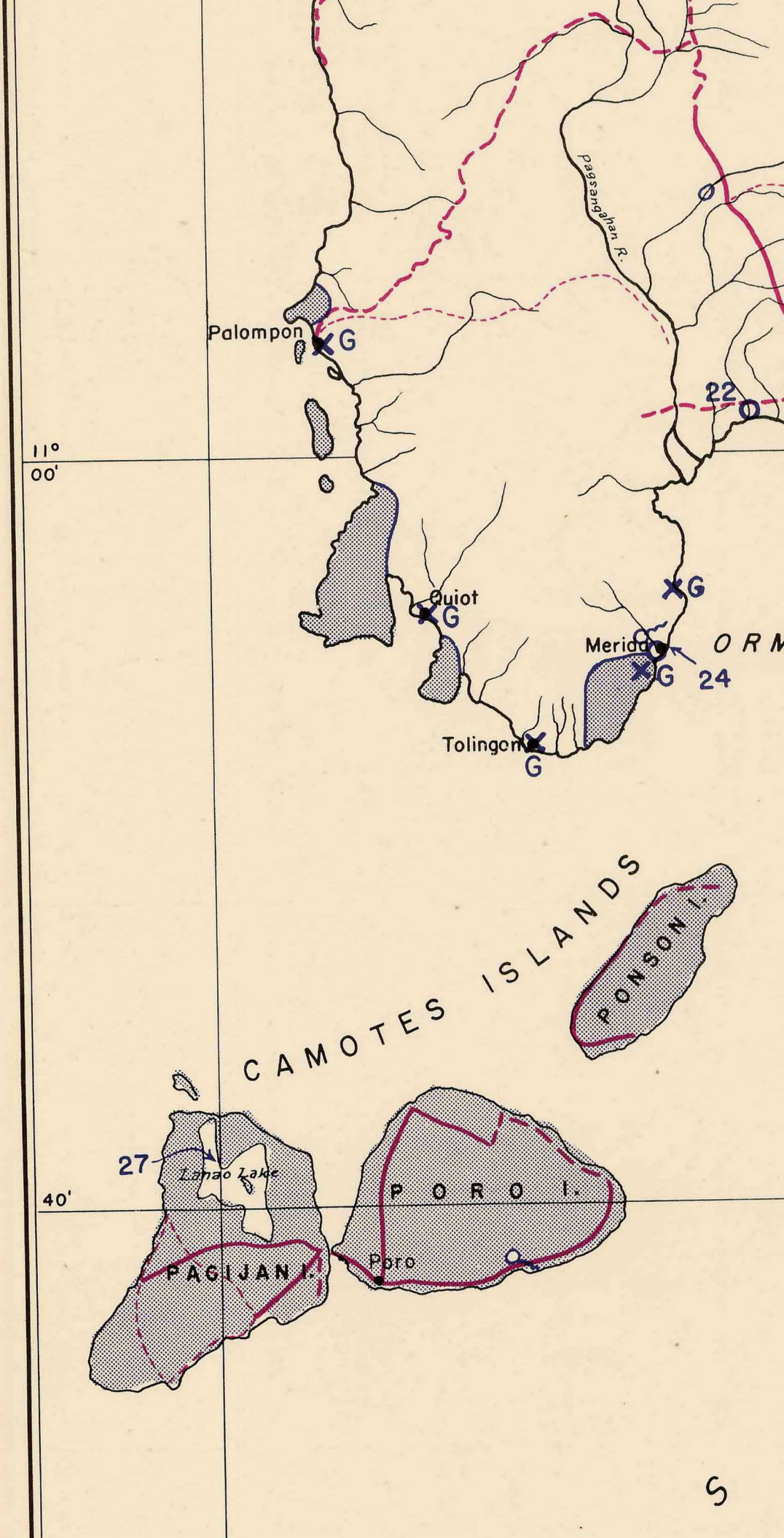
31. 13 dug wells, yield 3-4 gpm each.

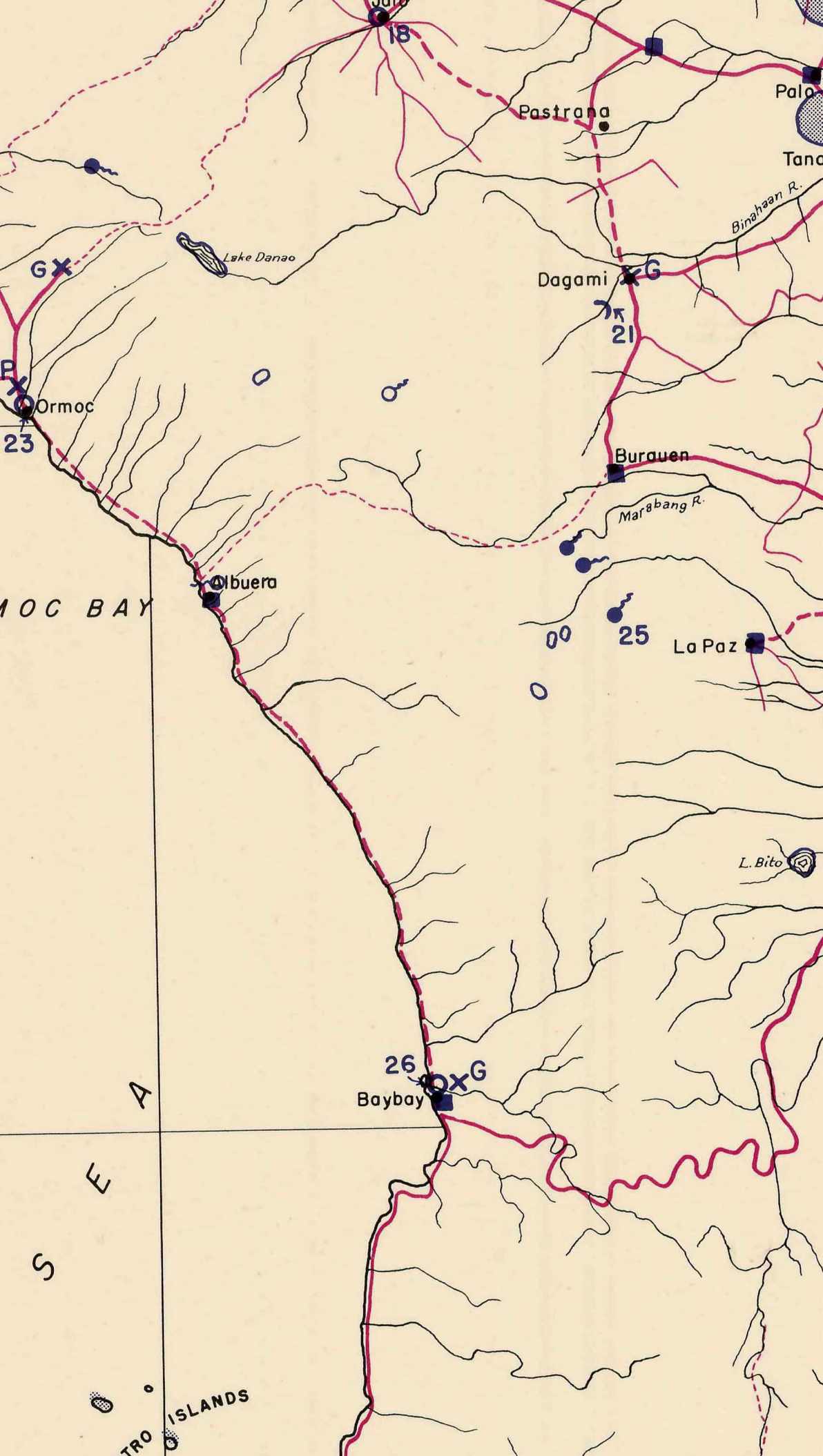
20'

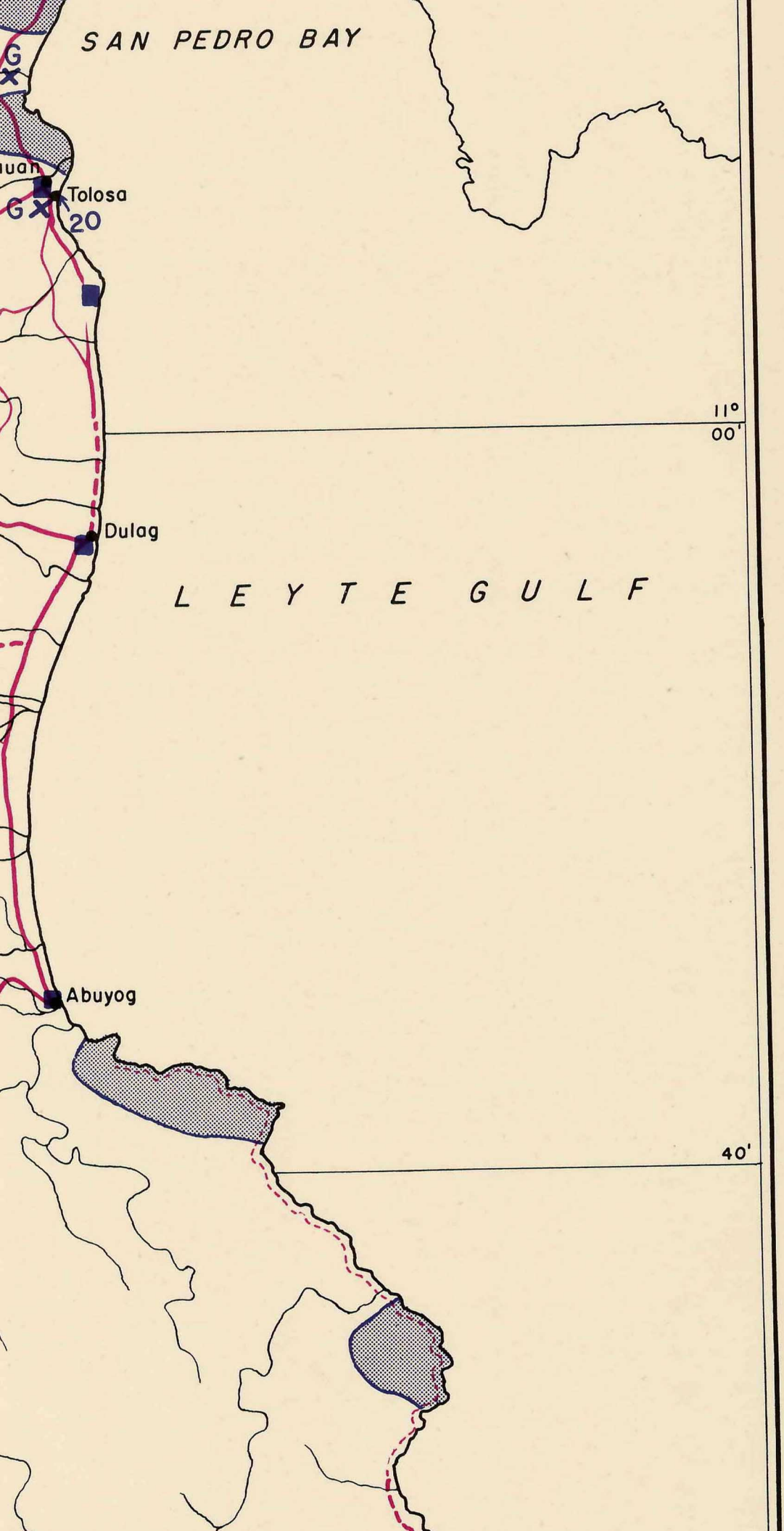
ibong Pt.

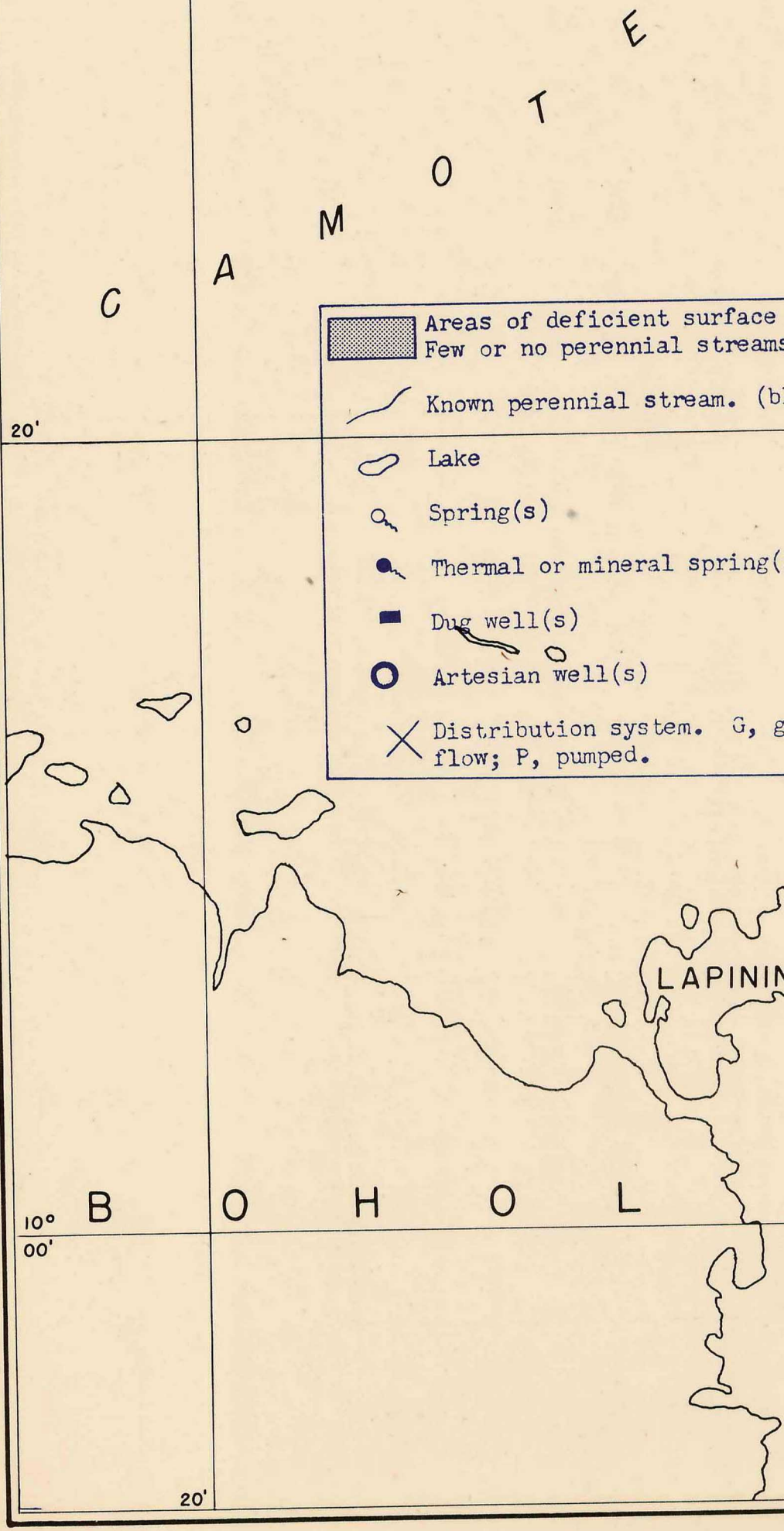
Tacloban

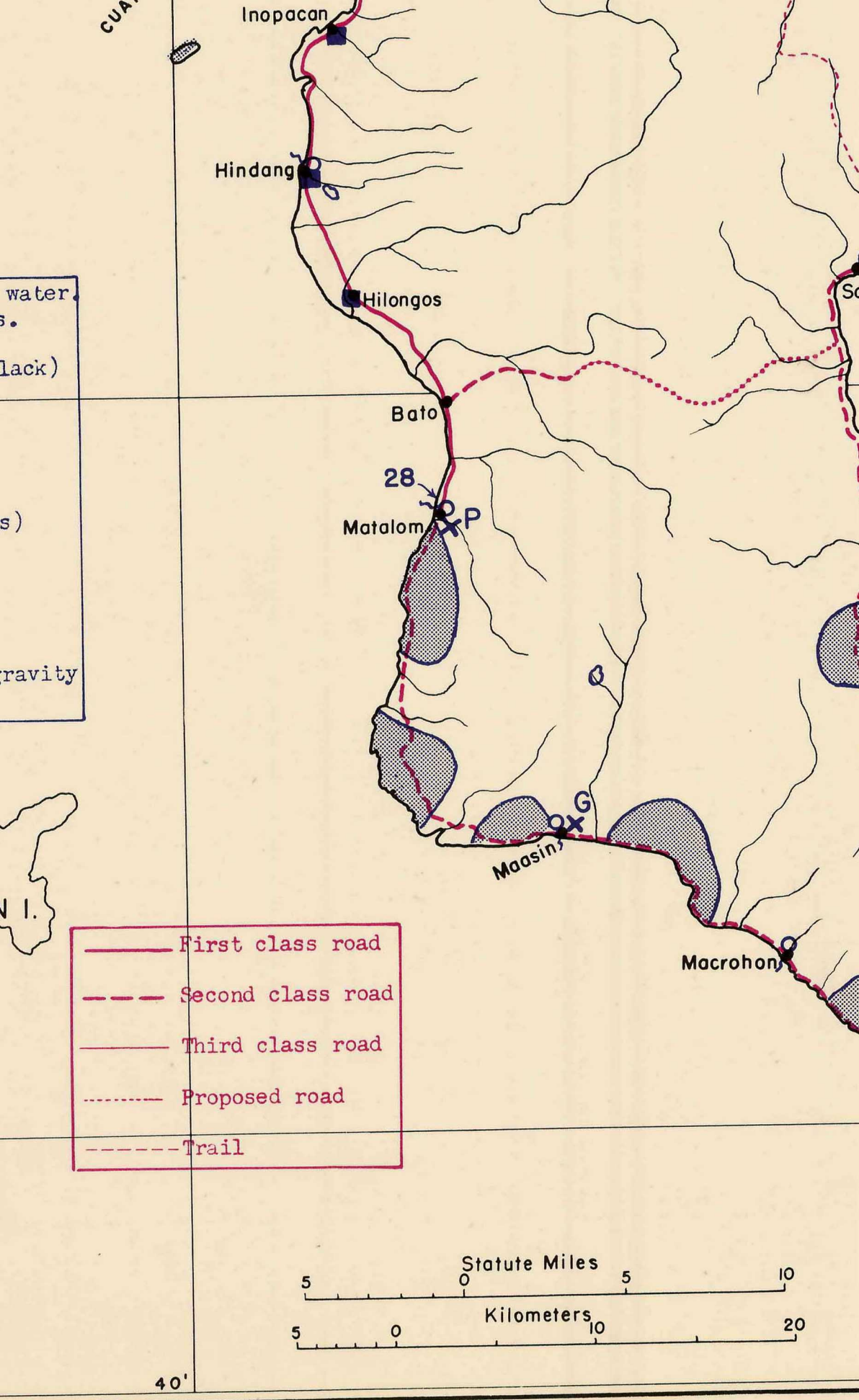
19


Pagsangahan R.
Palompon
G
22
11°
00'
Quiot
G
G
Merida
24
G
Tolingon
G
CAMOTES ISLANDS
PONSON I.
27
Lanao Lake
40'
P O R O I.
PAGIJAN I.
Poro

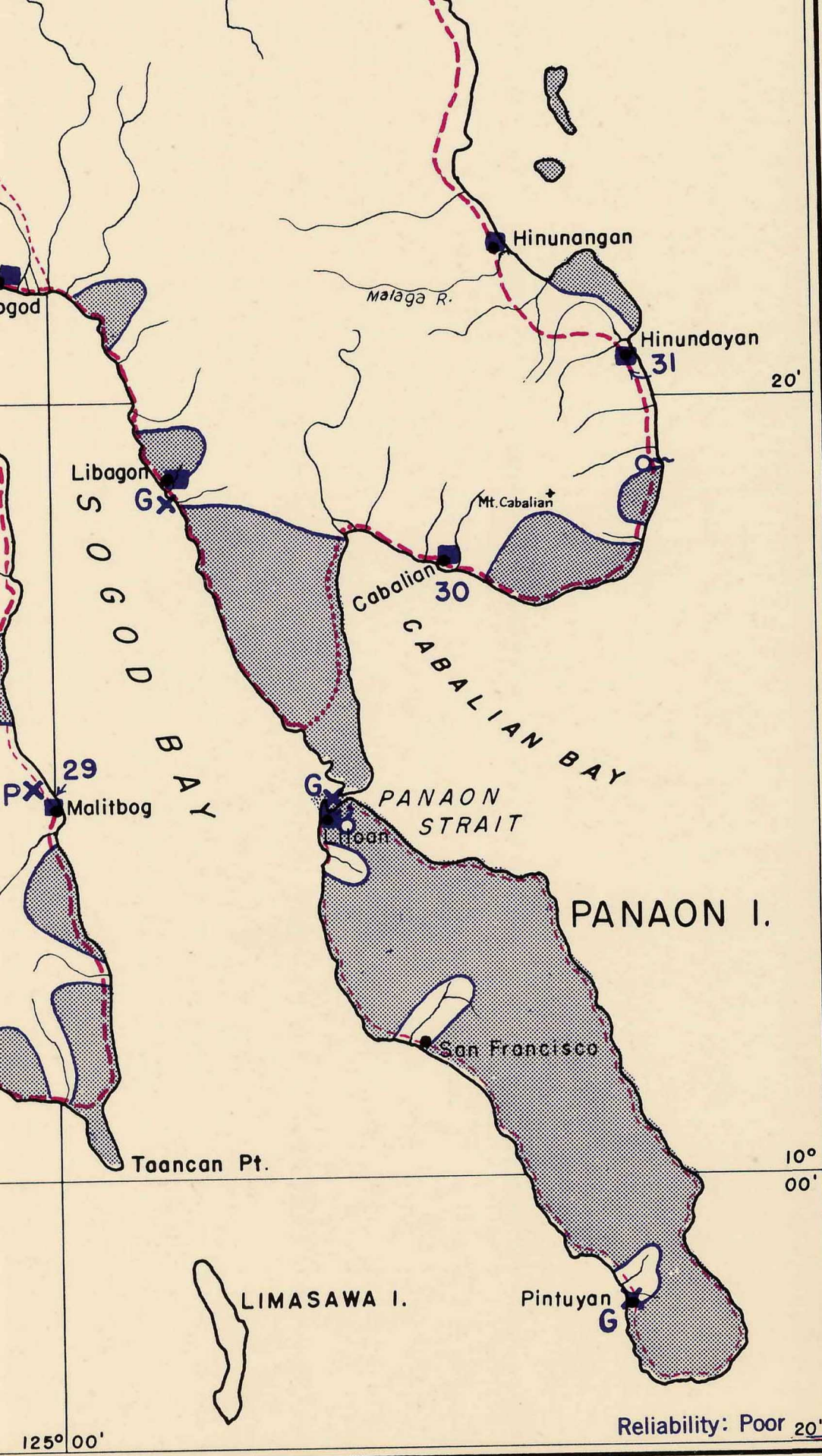

18
Pastrana
Pala
Tana
Binahaan R.
Lake Danao
G
Dagami
G
21
Ormoc
23
Burauen
Marabang R.
Albuera
MOC BAY
25
La Paz
L. Bito
26
G
Baybay
SEA
ISLANDS


SAN PEDRO BAY
Tolosa
20
11°
00'
Dulag
LEYTE GULF
Abuyog
40'


E
T
O
M
A
C
Areas of deficient surface
Few or no perennial streams
Known perennial stream. (b
20'
Lake
Spring(s)
Thermal or mineral spring(
Dug well(s)
Artesian well(s)
Distribution system. G, g
flow; P, pumped.
LAPINI
B O H O L
10°
00'
20'



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FOR
CHIEF OF ENGINEERS, U. S. ARMY

ANALYSES OF STREAMS, SPRINGS, AND WELLS

gpm = gallons per minute
ppm = parts per million
T = trace
N = nil
U = undetermined
- = no data

TYPE, PROVINCE	Location	Suspended Matter: Color	Alkalinity (rough field estimate unless figures given)	Date Sample Collected	Total Solids (ppm)	Mineral Matter (ppm)	Loss on Ignition (ppm)	Nitrogen as: Free NH_3 (ppm)	Nitrogen as: Albuminoids (NH_3) (ppm)	Nitrogen as: Nitrates (ppm)	Nitrogen as: Nitrates (ppm)	Chlorine (ppm)	Behavior of Residue on Ignition	Hardness: Permanent	Hardness: Temporary (ppm)	Non-scale-forming Ingredients (ppm)	Scale-forming Ingredients (ppm)	Silica (ppm)	Alumina (Al_2O_3) and (Fe_2O_3) (ppm)	Lime (CaO) (ppm)	Magnesia (MgO) (ppm)	Sulfuric Anhydride (SO_3) (ppm)
STREAMS, SAMAR	Ulut River, near Loquilocon	-	-	Sept., 1908	288.	196.0	92.0	0.012	-	-	-	8.50	Blackening	-	-	-	-	-	-	-	-	-
	Creek (Tibac Creek) 1/2 mile north of Catbalogan	Slightly brownish	Slightly alkaline	Sept., 1908	240	210	30.4	0.010	0.081	0.257	N	3.36	Slight blackening	-	-	-	-	-	-	-	-	-
	Amantaran Point Stream, Daram I.	Trace of suspended matter	0.00 by phenophthalein 0.42 by methyl orange	1938	306	280	26	-	-	-	-	11.65	-	-	127.5	45	236	-	-	-	-	-
STREAMS LEYTE	Palo River, near Palo	Yellowish color, reddish sediment	Slightly alkaline	Sept., 1908	128	96.4	31.2	0.133	0.253	0.097	N	4.95	Blackening	-	-	-	-	-	-	-	-	-
	Palo River, near Palo	Trace	0.03 by phenophthalein 0.26 by methyl orange	July, 1938	240	195	45	-	-	-	-	6.5	-	-	86.4	33	162	-	-	-	-	-
	Binahaan River, near Tanauan	"	0.03 by phenophthalein 0.20 by methyl orange	1938	256	206	50	-	-	-	-	8.2	-	-	98	56	150	-	-	-	-	-
	Malirong River, near Malirong	"	0.02 by phenophthalein 0.24 by methyl orange	July, 1938	241	192	49	-	-	-	-	6.5	-	-	99	43	149	-	-	-	-	-
	River (Hiraan River) near Hiraan, near Carigara	"	0.02 by phenophthalein 0.12 by methyl orange	1938	200	145	55	-	-	-	-	4.5	-	-	49	25	120	-	-	-	-	-
	River near Tunga	"	"	1938	202	141	61	-	-	-	-	3.1	-	-	47	17	124	-	-	-	-	-
	Matugue (Villanueva) River, near mouth (near Calubian)	Clear	0.00 by phenophthalein	1938	360	280	80	-	-	-	-	10.9	-	-	144	77	204	-	-	-	-	-
	Daguitan River, near Barauen	Trace	0.00 phenophthalein 0.18 methyl orange	1938	143	103	40	-	-	-	-	4.5	-	-	59	7	96	-	-	-	-	-
SPRINGS, LEYTE	At Cabucgayan, Biliran Island	"	0.00 phenophthalein 0.15 methyl orange	June, 1938	239	197	42	-	-	-	-	8.2	-	-	80	70	127	-	-	-	-	-
	At Caibiran, Biliran Island	"	0.00 phenophthalein 0.17 methyl orange	1938	191	151	40	-	-	-	-	7.6	-	-	84	27	124	-	-	-	-	-
	Near Biliran, Biliran Island	"	0.00 phenophthalein 0.12 methyl orange	1938	156	123	33	-	-	-	-	10.0	-	-	83	12	111	-	-	-	-	-
	At Liko, near Naval, Biliran Island	Clear	0.00 phenophthalein	1938	226	173	53	-	-	-	-	6.9	-	-	60	14	159	-	-	-	-	-
	Villahermosa, near San Isidro	"	"neutral"	Dec, 1913	436	-	-	-	-	T	N	45.8	-	-	(as HCO_3 = 386)	-	-	21.7	T	(as Ca = 94.4)	(as Mg = 14.0)	(as SO_4 = 11.2)
SPRINGS, SAMAR	Villahermosa Hot Spring, near Catbalogan	"	Alkaline	Sept., 1908	446	408	38.4	0.002	0.029	T	0.056	53.86	-	-	-	-	-	-	-	-	-	-
	Naval Hot Spring, reported near Catbalogan, but may be near Naval, Biliran I.	Taste and odor of petroleum	Alkaline	Sept., 1908	716	630	116.4	0.109	0.080	N	N	29.31	Slight darkening	-	-	-	-	-	-	-	-	-
DEEP WELLS, LEYTE	Carigara; 170 feet deep	Somewhat greenish color, slightly turbid	Alkaline	Apr, 1909	1274	1241	32.8	1.328	0.024	N	N	34.7	-	N	950.5	-	-	108.8	2.0	383.5	102.9	8.70
	Carigara, Sawang	Reddish sediment	Alkaline	May, 1909	1304	1237	67.0	1.413	0.096	N	N	35.92	Darkening of reddish sediment	-	-	-	-	113.6	4.0	330.0	118.6	13.0
	Carigara; 171 feet deep	Slightly turbid	Alkaline	June, 1909	1485	1396.8	88.4	1.570	0.024	T	N	43.36	-	N	1052	-	-	-	-	-	-	-
	Carigara; 227 feet deep	Slightly turbid	Alkaline	June, 1909	1180	1181.2	99.2	0.116	0.014	T	0.920	38.76	Browning	N	826.6	-	-	-	-	-	-	-
	Baybay; 475 feet deep; flows 5 gpm; pumps 11 gpm	Nearly clear, slight turbidity	Alkalinity 220; acidity (CO_2) 4.6	-	820	-	-	-	-	-	-	310	-	-	(as HCO_3 = 270)	-	-	55	(as Fe = 1.0)	(as Ca = 37)	(as Mg = 14)	N
	Baybay; 354 feet deep; flows 6 gpm; pumps 14 gpm	Clear, some turbidity	Alkalinity 220; acidity nil	-	810	-	-	-	-	-	-	300	-	-	(as HCO_3 = 270)	-	-	35	(as Fe = 0.66)	(as Ca = 34)	(as Mg = 25)	T
DEEP WELLS, SAMAR	Catbalogan; deep well	-	"neutral"	Sept, 1909	1314	1237	77.2	0.323	0.019	T	0.717	34.51	Slight browning	-	-	-	-	-	-	-	-	-
	Catbalogan; 794 feet deep, pumps 28.5 gpm	Brownish, slightly turbid, odorless	Slightly alkaline	Jan, 1912	424	401	23.2	0.376	0.087	0.027	0.003	54.53	-	N	243.4	371.8	29.0	37.9	0.2	2.1	T	28.3
	Wright, 1,020 feet deep, flows 1.5 gpm, pumps 6 gpm	Slightly brownish	Alkaline	Aug, 1912	994	482	11.8	3.320	0.326	U	T	147.5	Blackening, burnt organic odor	-	-	918.2	33.8	-	-	-	-	-
	Villareal; 1,050 feet deep, pumps 9.5 gpm	Slightly brownish	Alkaline	Oct, 1913	1382.4	-	-	1.510	0.555	T	T	294.0	-	-	-	-	-	19	T	(as Ca = 33)	(as Mg = 23)	(as SO_4 = 157)

MUNICIPAL DISTRIBUTION SYSTEMS

Source: E.R.O. Special Rept. No. 45 (Philippine Islands), Vol. III
Conditions as of 1931

Leyte

Municipality	Cost (Pesos) (1 Peso = 50 Cents)	Population Served	Type of System	Capacity of System (gal/day)
Baybay	72,889	8,000	Gravity	136,800
Baybay Agricultural School	7,954	500	"	72,000
Calubian	3,739	700	"	72,000
Capoocan	746	900	"	4,320
Carigara Army Cadre	1,200	200	Pumping	5,000
Libagon	5,670	1,000	Gravity	20,000
Liloan (Panaon Island)	7,484	700	"	28,800
Masin	21,000	3,300	"	72,000
Malitbog Army Cadre	2,000	200	Pumping	5,000
Matalom Army Cadre	1,300	200	"	5,000
Merida	9,741	1,000	Gravity	28,800
Bo. Libas, Merida	--	600	"	21,600
Bo. Quiot, Merida	9,854	1,000	"	28,800
Bo. Tolingon, Merida	--	800	"	28,800
Maripipi (Maripipi Island)	3,278	1,000	"	16,400
Ormoc Army Cadre	10,000	350	Pumping	10,000
Bo. Dolores, Ormoc	9,104	500	Gravity	43,200
Palompon	59,313	3,500	"	144,000
Pintuyan (Panaon Island)	4,382	1,000	"	72,000
Tacloban Army Cadre	1,600	350	Pumping	14,400
Villaba	8,531	1,700	Gravity	36,000

Samar

Municipality	Cost (Pesos) 1 Peso = 50 Cents	Population Served	Type of System	Capacity of System (gal/day)
Calbayog	--	Market	Gravity	20,000
Catbalogan	64,309	2,000	"	35,000
Catbalogan Improvement	15,000	--	"	223,000
Catbalogan Army Cadre	45,000	400	"	28,000
Oras	--	4,000	"	(about 1,000 in 1923)
Taranagnan	5,984	8,500	"	31,680
Wright	43,544	3,000	"	108,000
Zumarraga	3,008	--	Reservoir	30,000

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

TYPE, PROVINCE	Location	Suspended Matter: Color	Alkalinity (rough field estimate unless figures given)	Date Sample Collected	Tota Solid (ppm
STREAMS, SAMAR	Ulut River, near Loquilocon	-	-	Sept., 1908	288.
	Creek (Tibac Creek) 1/2 mile north of Catbalogan	Slightly brownish	Slightly alkaline	Sept., 1908	240
	Amantaran Point Stream, Daram I.	Trace of suspended matter	0.00 by phenophthalein 0.42 by methyl orange	1938	306
STREAMS LEYTE	Palo River, near Palo	Yellowish color, reddish sediment	Slightly alkaline	Sept., 1908	128
	Palo River, near Palo	Trace	0.03 by phenophthalein 0.26 by methyl orange	July, 1938	240
	Binahaan River, near Tanauan	"	0.03 by phenophthalein 0.20 by methyl orange	1938	256
	Malirong River, near Malirong	"	0.02 by phenophthalein 0.24 by methyl orange	July, 1938	241
	River (Hiraan River) near Hiraan, near Carigara	"	0.02 by phenophthalein 0.12 by methyl orange	1938	200

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ANALYSES OF STREAMS, SPRINGS, AND WELLS

gpm = gallons per minute
ppm = parts per million
T = trace
N = nil
U = undetermined
- = no data

l s)	Mineral Matter (ppm)	Loss on Ignition (ppm)	Nitrogen as				Chlorine (ppm)	Behavior of Residue on Ignition	H Perma nent
			Free NH_3 (ppm)	Albuminoids (NH_3) (ppm)	Nitrates (ppm)	Nitrates (ppm)			
.	196.0	92.0	0.012	-	-	-	8.50	Blackening	-
	210	30.4	0.010	0.081	0.257	N	3.36	Slight blackening	-
	280	26	-	-	-	-	11.65	-	-
	96.4	31.2	0.133	0.253	0.097	N	4.95	Blackening	-
	195	45	-	-	-	-	6.5	-	-
	206	50	-	-	-	-	8.2	-	-
	192	49	-	-	-	-	6.5	-	-
	145	55	-	-	-	-	4.5	-	-

WATER SUPPLY: EXISTING SOURCES

ardness		Non-scale-forming Ingredients (ppm)	Scale-forming Ingredients (ppm)	Silica (ppm)	Alumina (Al_2O_5) and (Fe_2O_3) (ppm)	Lime (CaO) (ppm)	Magnesia (MgO) (ppm)	Sulfuric Anhydride (SO_3) (ppm)
-	Tempo-rary (ppm)							
-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
127.5	45	236	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-
86.4	33	162	-	-	-	-	-	-
98	56	150	-	-	-	-	-	-
99	43	149	-	-	-	-	-	-
49	25	120	-	-	-	-	-	-

	River near Tunga	"	"	1938	202
	Matugue (Villanueva) River, near mouth (near Calubian)	Clear	0.00 by phenophthalein	1938	360
	Daguitan River, near Barauen	Trace	0.00 phenophthalein 0.18 methyl orange	1938	143
SPRINGS, LEYTE	At Cabucgayan, Biliran Island	"	0.00 phenophthalein 0.15 methyl orange	June, 1938	239
	At Caibiran, Biliran Island	"	0.00 phenophthalein 0.17 methyl orange	1938	191
	Near Biliran, Biliran Island	"	0.00 phenophthalein 0.12 methyl orange	1938	156
	At Liko, near Naval, Biliran Island	Clear	0.00 phenophthalein	1938	226
	Villahermosa, near San Isidro	"	"neutral"	Dec, 1913	43
SPRINGS, SAMAR	Villahermosa Hot Spring, near Catbalogan	"	Alkaline	Sept, 1908	44
	Naval Hot Spring, reported near Catbalogan, but may be near Naval, Biliran I.	Taste and odor of petroleum	Alkaline	Sept, 1908	74
DEEP WELLS, LEYTE	Carigara; 170 feet deep	Somewhat greenish color, slightly turbid	Alkaline	Apr, 1909	127
	Carigara, Sawang	Reddish sediment	Alkaline	May, 1909	130
	Carigara; 171 feet deep	Slightly turbid	Alkaline	June, 1909	148
	Carigara; 227 feet deep	Slightly turbid	Alkaline	June, 1909	118
	Baybay; 475 feet deep; flows 5 gpm; pumps 11 gpm	Nearly clear, slight turbidity	Alkalinity 220; acidity (CO_2) 4.6	-	82
	Baybay; 354	Clear, some	Alkalinity	-	81

	141	61	-	-	-	-	3.1	-	-
	280	80	-	-	-	-	10.9	-	-
	103	40	-	-	-	-	4.5	-	-
	197	42	-	-	-	-	8.2	-	-
	151	40	-	-	-	-	7.6	-	-
	123	33	-	-	-	-	10.0	-	-
	173	53	-	-	-	-	6.9	-	-
	-	-	-	-	T	N	45.8	-	-
	408	38.4	0.002	0.029	T	0.056	53.86	-	-
	630	116.4	0.109	0.080	N	N	29.31	Slight darkening	-
	1241	32.8	1.328	0.024	N	N	34.7	-	
	1237	67.0	1.413	0.096	N	N	35.92	Darkening of reddish sediment	
	1396.8	88.4	1.570	0.024	T	N	43.36	-	
	1181.2	99.2	0.116	0.014	T	0.920	38.76	Browning	
	-	-	-	-	-	-	310	-	
	-	-	-	-	-	-	300	-	

	47	17	124	-	-	-	-	-
	144	77	204	-	-	-	-	-
	59	7	96	-	-	-	-	-
	80	70	127	-	-	-	-	-
	84	27	124	-	-	-	-	-
	83	12	111	-	-	-	-	-
	60	14	159	-	-	-	-	-
	(as HCO_3 = 386)	-	-	21.7	T	(as Ca = 94.4	(as Mg = 14.0)	(as SO_4 = 11.2)
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
N	950.5	-	-	108.8	2.0	383.5	102.9	8.70
	-	-	-	113.6	4.0	330.0	148.6	13.0
N	1052	-	-	-	-	-	-	-
N	826.6	-	-	-	-	-	-	-
	(as HCO_3 = 270)	-	-	55	(as Fe = 1.0)	(as Ca = 37)	(as Mg = 14)	N
	(as HCO_3 = 270)	-	-	35	(as Fe = 0.66)	(as Ca = 34)	(as Mg = 25)	T

	feet deep; flows 6 gpm; pumps 14 gpm	turbidity	220; acidity nil		
DEEP WELLS, SAMAR	Catbalogan; deep well	-	"neutral"	Sept, 1909	13
	Catbalogan; 794 feet deep, pumps 28.5 gpm	Brownish, slightly turbid, odorless	Slightly alkaline	Jan, 1912	4
	Wright, 1,020 feet deep, flows 1.5 gpm, pumps 6 gpm	Slightly brownish	Alkaline	Aug, 1912	9
	Villareal; 1,050 feet deep, pumps 9.5 gpm	Slightly brownish	Alkaline	Oct, 1913	14

Municipality	Cost (Pesos) (1 Peso = 50 Cents)	Popu
Baybay	72,889	
Baybay Agricultural School	7,954	
Calubian	3,739	
Capoocan	746	
Carigara Army Cadre	1,200	
Libagon	6,670	
Liloan (Panaon Island)	7,484	
Maasin	21,000	
Malitbog Army Cadre	2,000	
Matalom Army Cadre	1,300	
Merida	9,741	
Bo. Libas, Merida	--	
Bo. Quiot, Merida	9,854	
Bo. Tolingom, Merida	--	
Maripipi (Maripipi Island)	3,278	
Ormoc Army Cadre	10,000	
Bo. Dolores, Ormoc	9,104	
Palompon	59,313	
Pintuyan (Panaon Island)	4,382	
Tacloban Army Cadre	1,600	
Villaba	8,531	

14	1237	77.2	0.323	0.019	T	0.717	34.51	Slight browning
24	401	23.2	0.376	0.087	0.027	0.003	54.53	-
94	482	11.8	3.320	0.326	U	T	147.5	Blackening, burnt organic odor
82.4	-	-	1.510	0.555	T	T	294.0	-

MUNICIPAL DISTRIBUTION SYSTEMS

Source: E.R.O. Special Rept. No. 45 (Philippine Islands), Vol. III
Conditions as of 1931

Leyte

lation Served	Type of System	Capacity of System (gal/day)
8,000	Gravity	136,800
500	"	72,000
700	"	72,000
900	"	4,320
200	Pumping	5,000
1,000	Gravity	20,000
700	"	28,800
3,300	"	72,000
200	Pumping	5,000
200	"	5,000
1,000	Gravity	28,800
600	"	21,600
1,000	"	28,800
800	"	28,800
1,000	"	16,400
350	Pumping	10,000
500	Gravity	43,200
3,500	"	144,000
1,000	"	72,000
350	Pumping	14,400
1,700	Gravity	36,000

Municipality	Cost (Peso 1 Peso 50 Cents
Calbayog	--
Catbalogan	64,309
Catbalogan Improvement	15,000
Catbalogan Army Cadre	45,000
Oras	--
Tarangnan	5,994
Wright	43,544
Zumarraga	3,008

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-	-	-	-	-	-	-	-	-
N	243.4	371.8	29.0	37.9	0.2	2.1	T	28.3
-	-	948.2	33.8	-	-	-	-	-
-	-	-	-	19	T	(as Ca = 33)	(as Mg = 23)	(as SO_4 = 157)

Samar

s) =	Population Served	Type of System	Capacity of System (gal/day)
	Market	Gravity	20,000
	2,000	"	35,000
	--	"	223,000
	400	"	28,000
	4,000	"	(about 1,000 in 1923)
	8,500	"	31,680
	3,000	"	108,000
	--	Reservoir	30,000

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

PHILIPPINE ISLANDS 1:500,000

SUGGESTED AIRDROME SITES

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SAN BERNARDINO STRAIT

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)

LUZON

MASBATE ISLAND

TAGAPULA ISLAND

CATADUANES ISLAND

MAQUEDA CHANNEL

BATAN I

RAPU RAPU I

BATAG I

LAOANG I

BALICUATRO ISLANDS

CAPUL I

DALUPIRI I

NARANJO ISLANDS

LAGONOY GULF

ALBAY GULF

SAMAR SEA

NORTH PACIFIC OCEAN

S A M A R

Landing fields in existence in 1941. All small.

Airfield reported under construction in February 1944. Locations approximate only.

17 Areas which probably contain suitable airdrome sites. Some swampy land probably included, also probably some areas of low hills less than 50 feet in elevation. In general, the areas are low, flat, coastal plains.

Reliability: Fair

1 250 000 YARDS

1 500 000 YARDS

Scale 1:500,000

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

A.M.S. S401
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMSM), U. S. Army, Washington, D. C., 1944.
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CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1° INCREASE
Do not use diagram except to obtain numerical value of angles

CONVERSION GRAPH NOT at the scale of the map.
Meters / Feet

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
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- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, less than 3'6" gauge
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- Telephone and Telegraph Line
- Power Transmission Line
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- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove

COVERAGE DIAGRAM

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INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliability fair)
3. Luzon Oil Map, 1:200,000 (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

PROVINCES
1. ALBAY
2. SORSOGON
3. SAMAR
4. MASBATE

Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

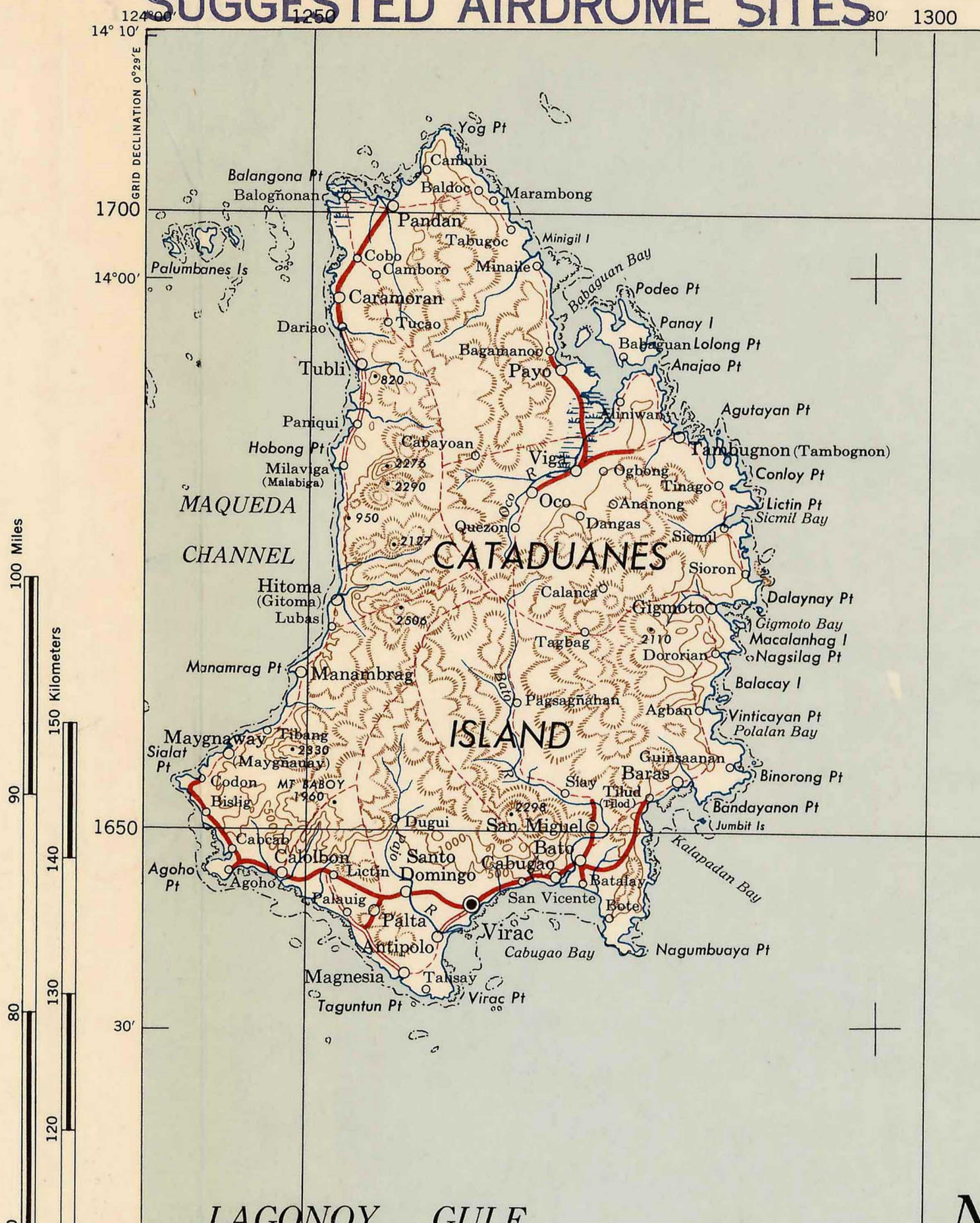
HEIGHTS IN FEET AND DEPTHS IN FATHOMS

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090 D-44

PHILIPPINE ISLANDS 1:500,000

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SUGGESTED AIRDROME SITES

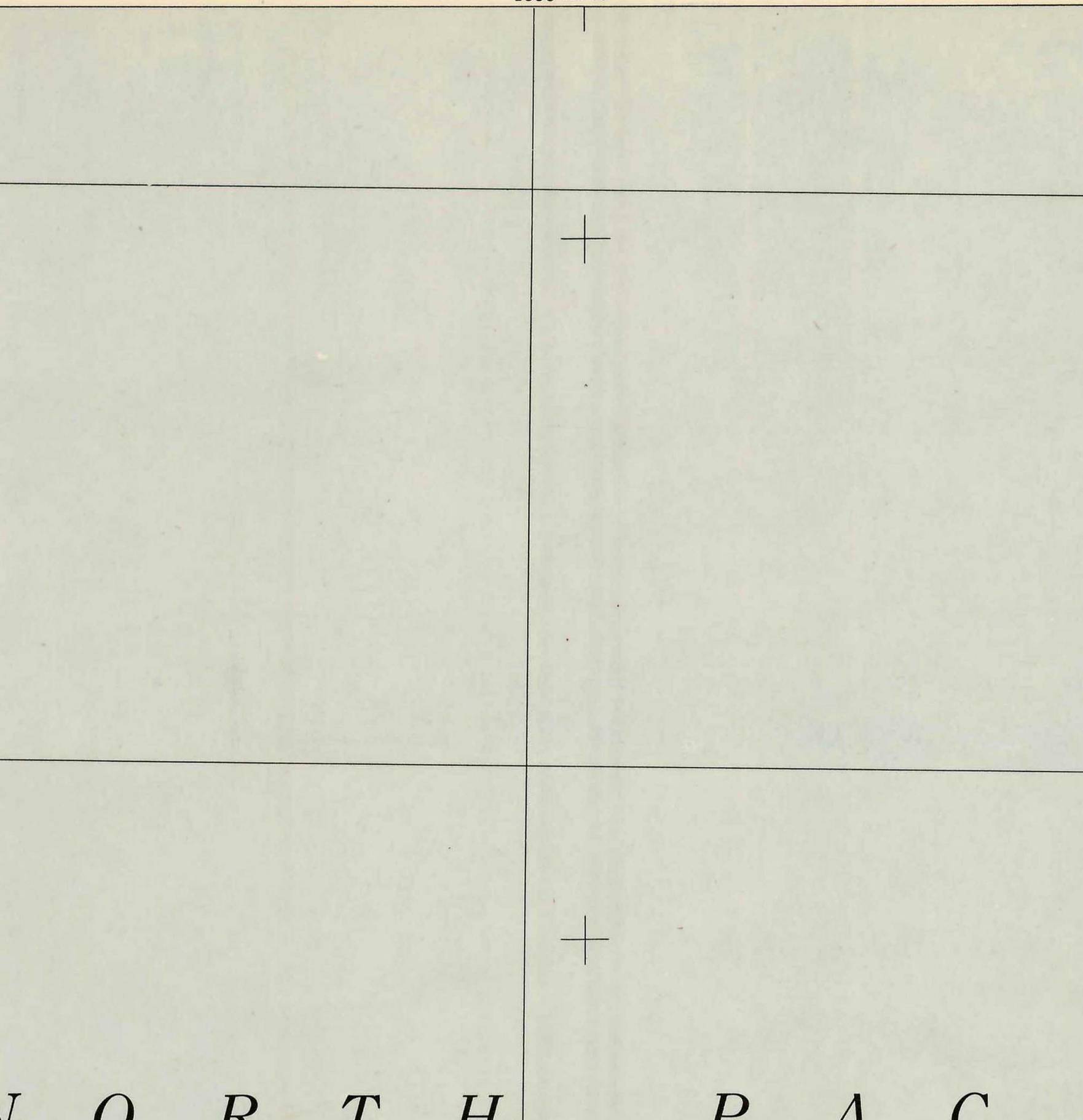


[redacted]

gencies only
tion

SAN BERNARDINO STRAIT

1350 125°00′



SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)

1400 30′ 1450 126°00′

14° 10′

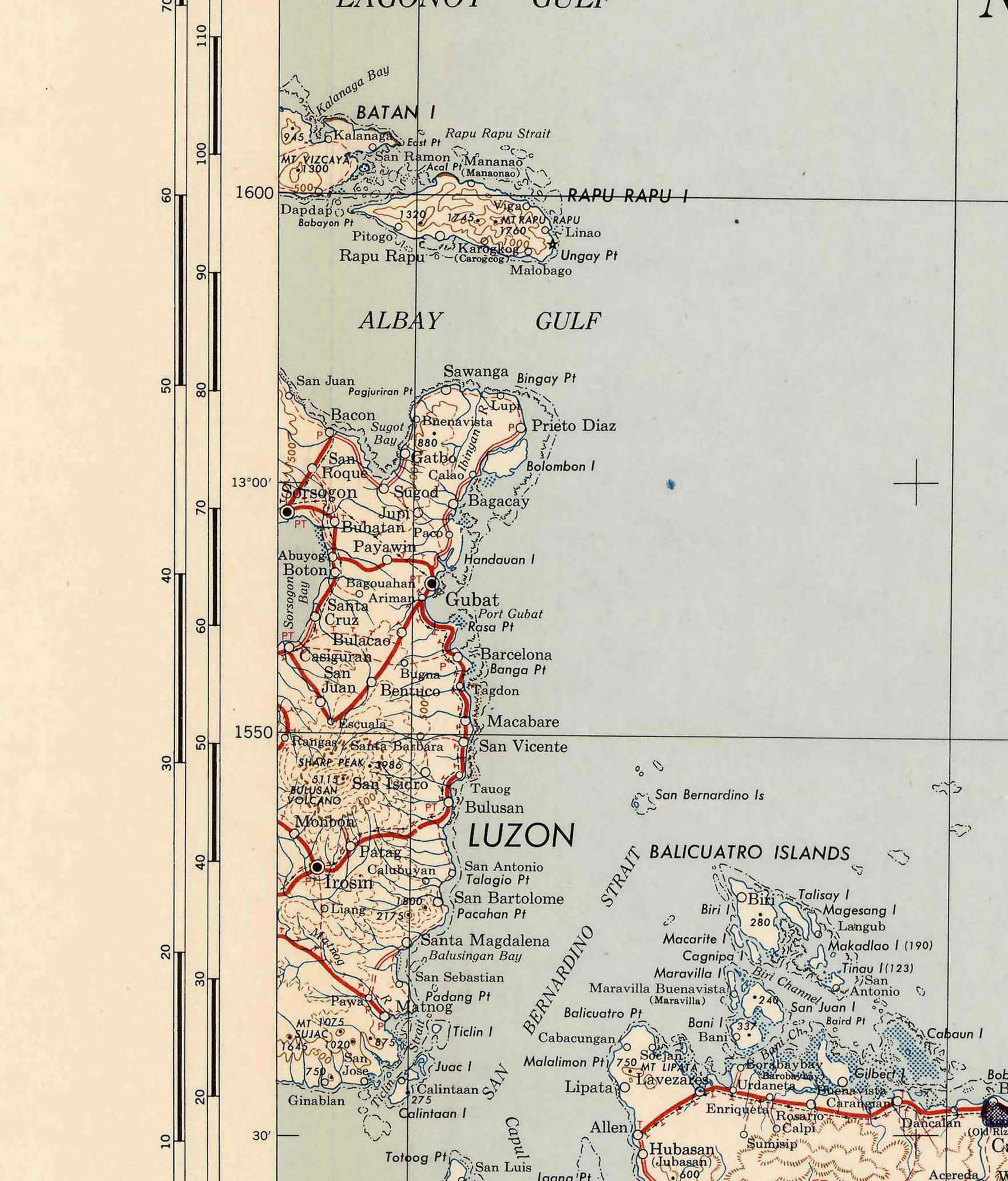
GRID DECLINATION 0°58′E

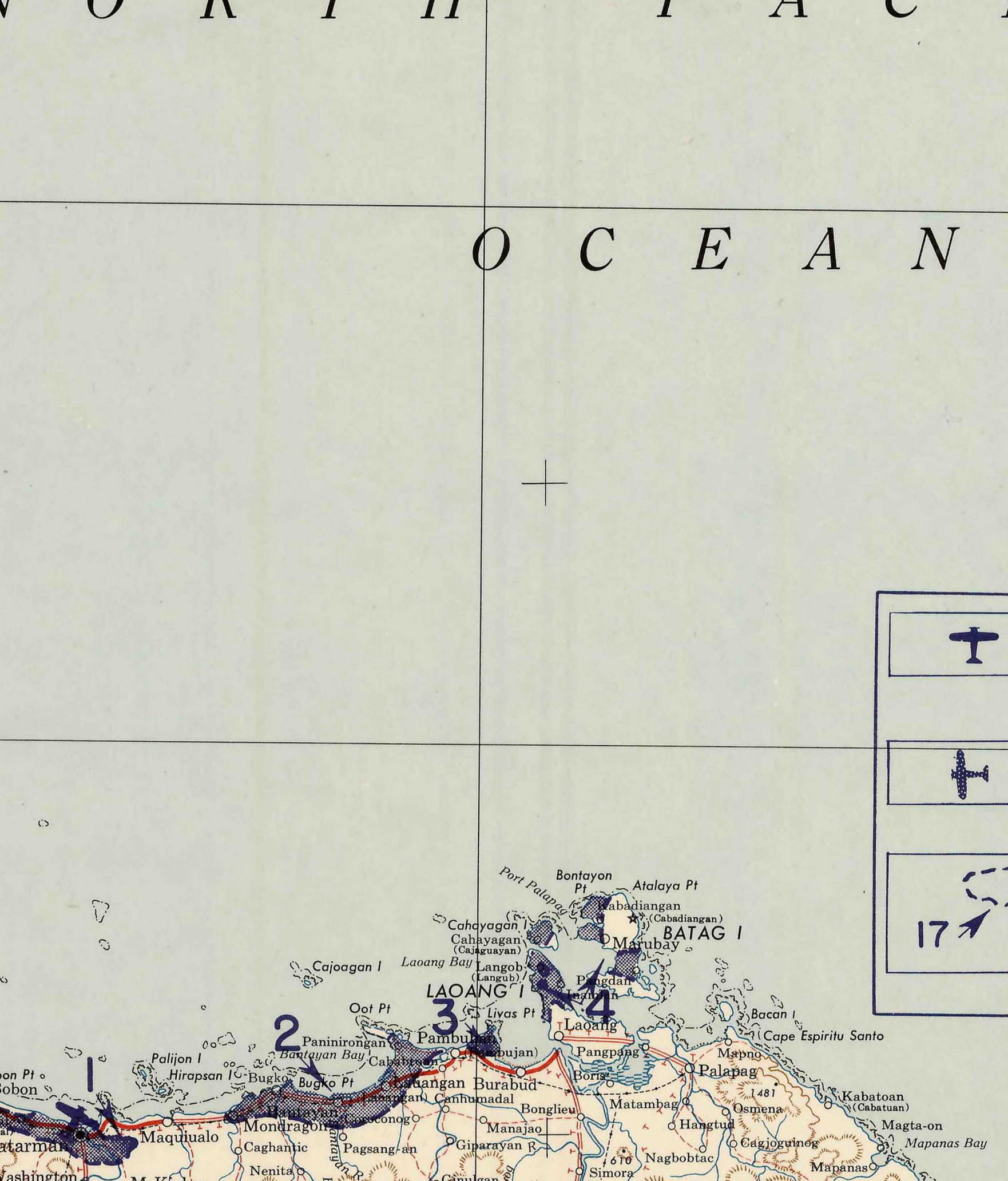
1700

14°00′

1650

30′


LAGONOY GULF
Kalanaga Bay
BATAN I
945
Kalanaga
East Pt
Rapu Rapu Strait
MT VIZCAYA
1300
San Ramon
Acal Pt
Mananao
(Manaonao)
500
1600
RAPU RAPU I
Dapdap
Babayon Pt
1320
1745
MT RAPU RAPU
1760
Viga
Linao
Pitogo
Karogkog
(Carogcog)
1000
Ungay Pt
Rapu Rapu
Malobago
ALBAY GULF
San Juan
Pagjuriran Pt
Sawanga
Bingay Pt
Lupi
Bacon
Sugot Bay
Buenavista
Prieto Diaz
880
Ibingan R
San Roque
Gatbo
Calao
Bolombon I
13°00′
Sorsogon
Sugod
Bagacay
Jupi
Buhatan
Paco
Payawin
Abuyog
Handauan I
Boton
Bagouahan
Ariman
Gubat
Sorsogon Bay
Santa Cruz
Port Gubat
Rasa Pt
Bulacao
Casigurán
Barcelona
Banga Pt
San Juan
Bentuco
Bugna
Tagdon
Escuala
Macabare
1550
Rangas
Santa Barbara
San Vicente
SHARP PEAK
3980
5115
BULUSAN VOLCANO
San Isicro
Tauog
Bulusan
San Bernardino Is
Monbon
LUZON
Patag
San Antonio
Calubuyan
Talagio Pt
Irosin
San Bartolome
1800
Liang
2175
Pacahan Pt
Matnog
Santa Magdalena
Balusingan Bay
San Sebastian
Padang Pt
Pawa
Matnog
MT 1075
SUJAC
1645
1020
875
Ticlin I
Ticlin Strait
San
Jose
750
Juac I
Calintaan
Ginablan
275
Calintaan I
SAN BERNARDINO STRAIT
BALICUATRO ISLANDS
Biri
Talisay I
Biri I
Magesang I
280
Langub
Macarite I
Makadlao I (190)
Cagnipa I
Maravilla I
Tinau I (123)
Biri Channel
San
Antonio
Maravilla Buenavista
(Maravilla)
240
San Juan I
Balicuatro Pt
Bani I
337
Baird Pt
Cabacungan
Bani
Cabaun I
Malalimon Pt
Soejan
750
MT LIPATA
Borabaybay
Barobaybay
Gilbert I
Lipata
Lavezares
Urdaneta
Buenavista
Carangian
Enriqueta
Rosario
Calpi
Dancalan
Allen
Sumisip
Hubasan
(Jubasan)
600
Totoog Pt
San Luis
Capul
30′


OCEAN
Port Palapag
Bontayon Pt
Atalaya Pt
Cabadiangan
(Cabadiangan)
Cahayagan I
Cahayagan
(Cajaguayan)
BATAG I
Marubay
Cajoagan I
Laoang Bay
Langob
(Langub)
Pangdan
Inambatan
LAOANG I
Oot Pt
Livas Pt
Laoang
Bacan I
Cape Espiritu Santo
Paninirongan
Bantayan Bay
Pambujan
(Pambujan)
Pangpang
Mapno
Palijon I
Hirapsan I
Cabahtan
Bugko
Bugko Pt
Boris
Palapag
Bobon
Catuangan
Burabud
Canhumadal
Matambag
1481
Kabatoan
(Cabatuan)
Bonglieu
Osmena
Maquiualo
Mondragon
Manajao
Hangtud
Magta-on
Caghantic
Pagsang-an
Giparayan R
Cagjoguinog
Mapanas Bay
Nenita
610
Nagbobtac
Simora
Mapanas
17

1600

13°00′

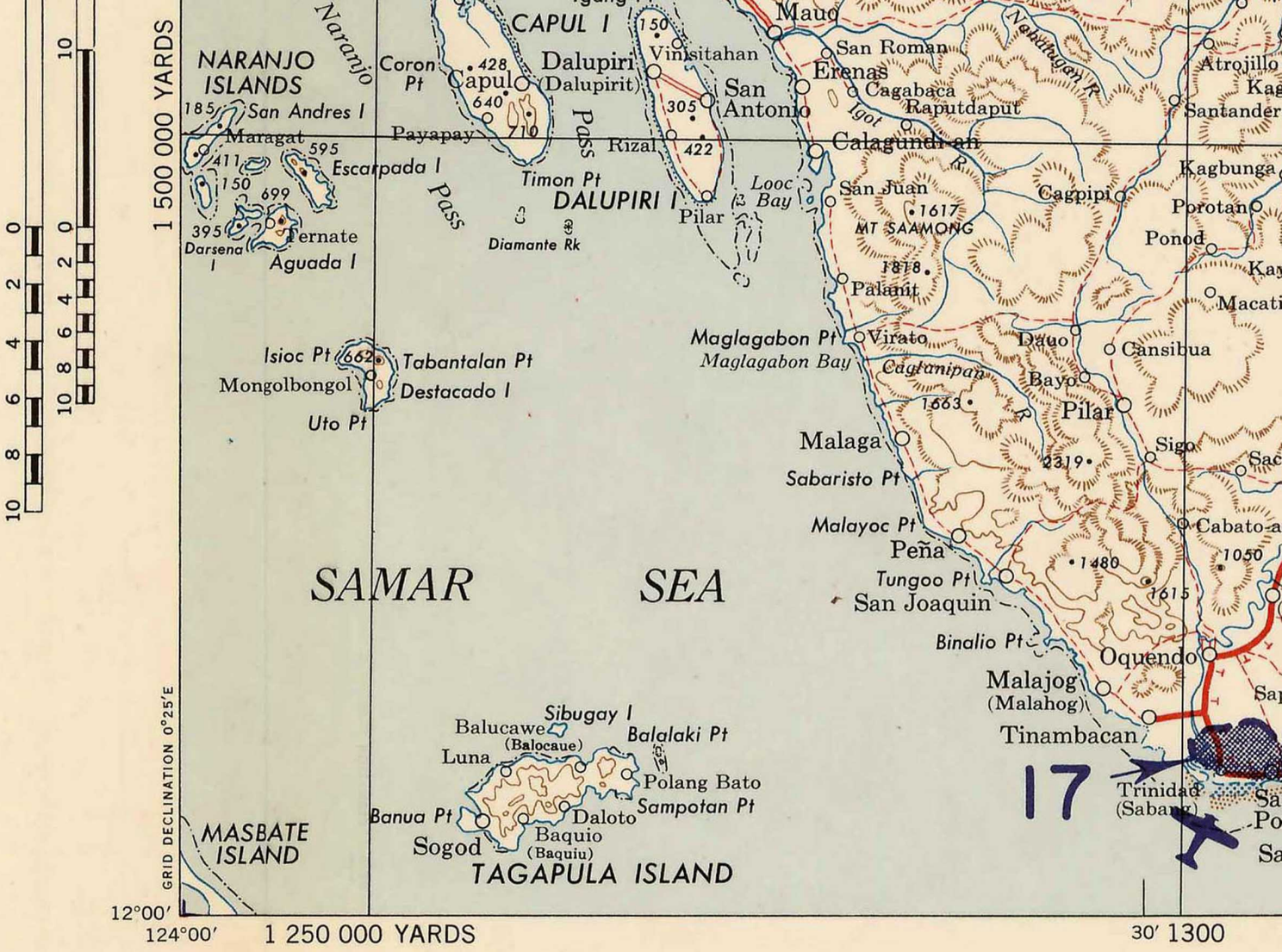
Landing fields in existence in 1941. All small.

Airfield reported under construction in February 1944. Locations approximate only.

Areas which probably contain suitable airdrome sites. Some swampy land probably included, also probably some areas of low hills less than 50 feet in elevation. In general, the areas are low, flat, coastal plains.

1550

30′



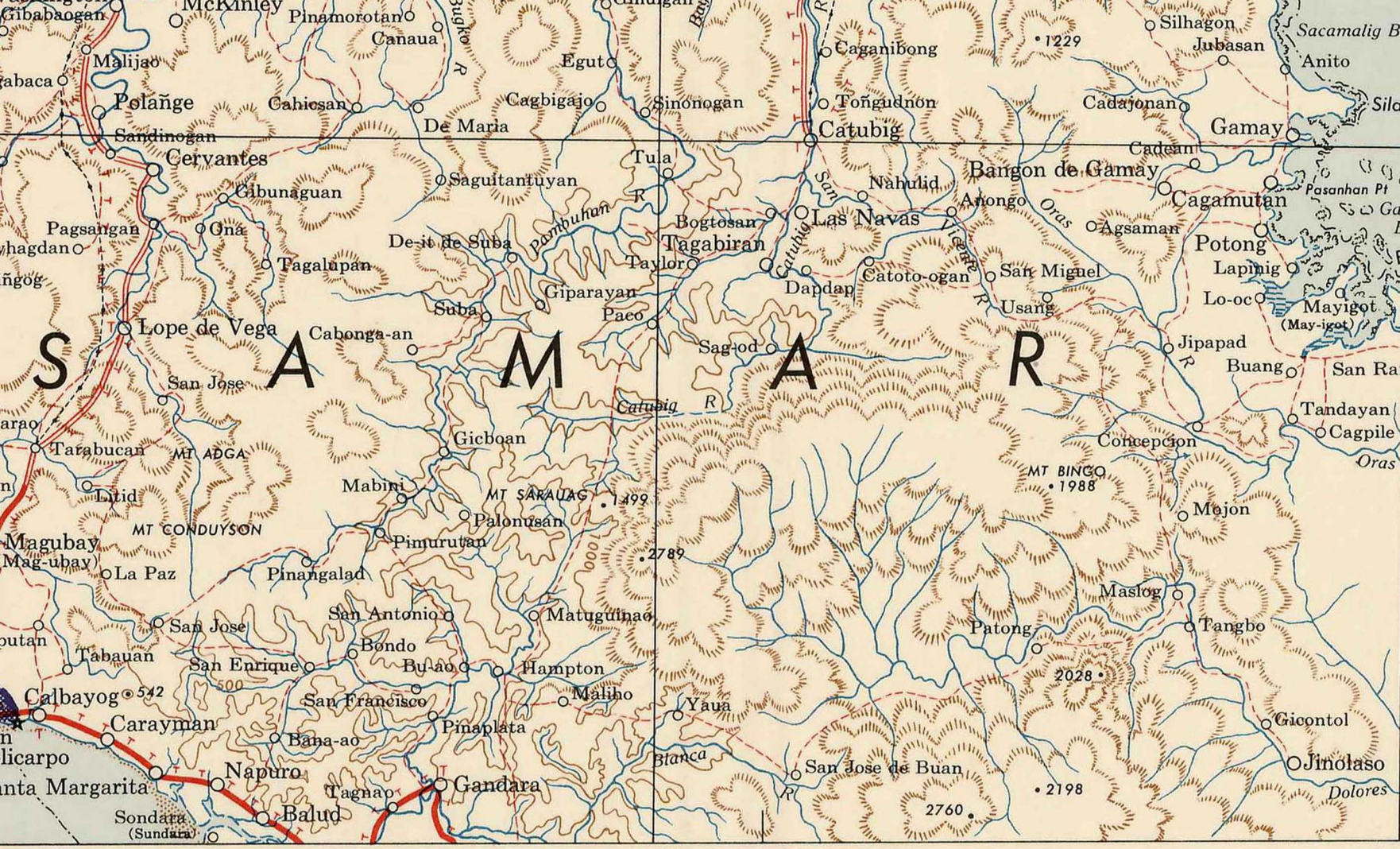
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CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
	2,000
500	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
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- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station — P T
- Mud Flat, Tidal Flat
- Mangrove



1350 125°00' 14

PREPARED BY U. S. GEOLOGICAL SUR
FOR
CHIEF OF ENGINEERS, U. S. ARMY

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

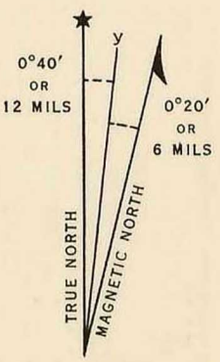
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

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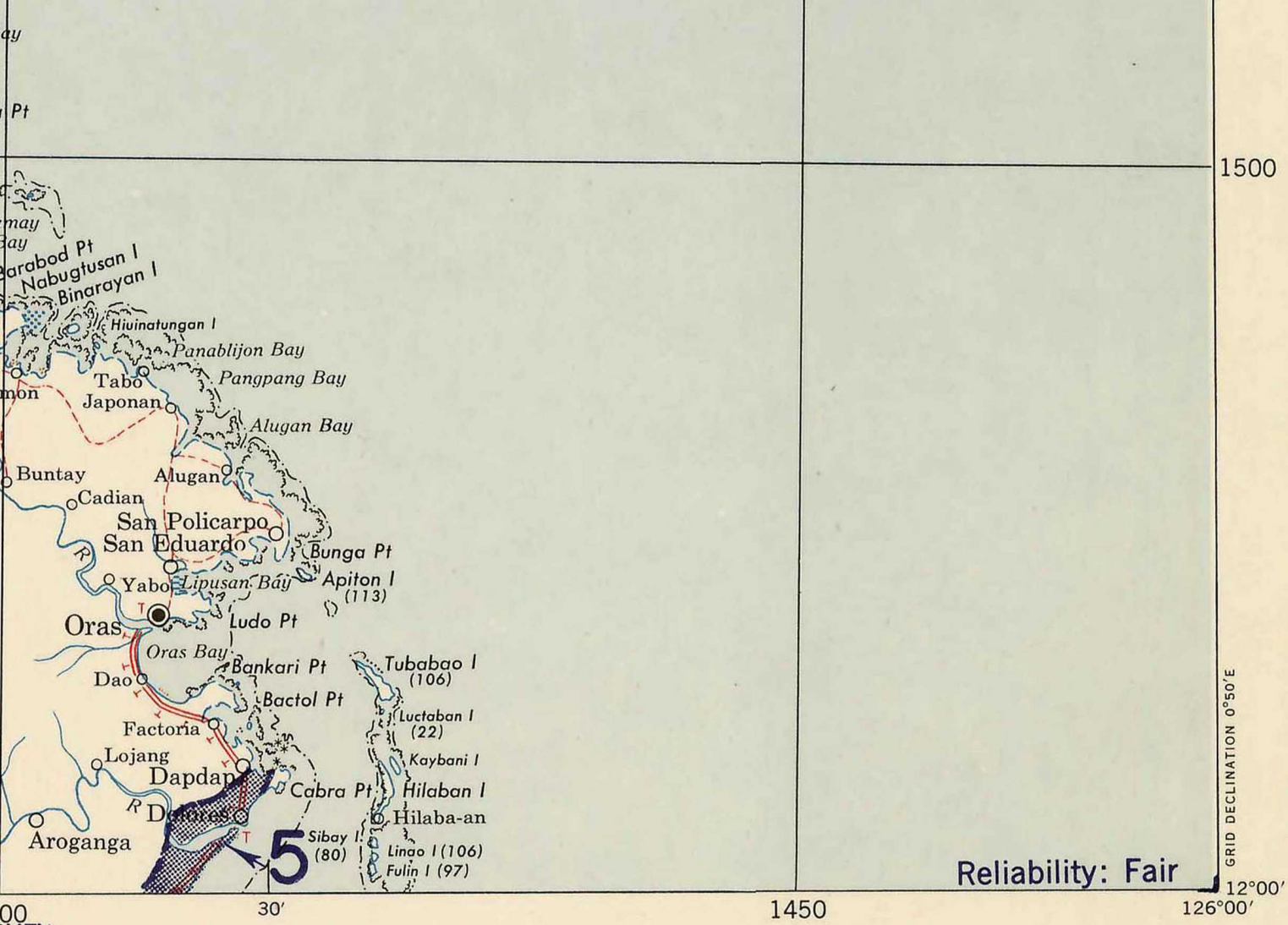


APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

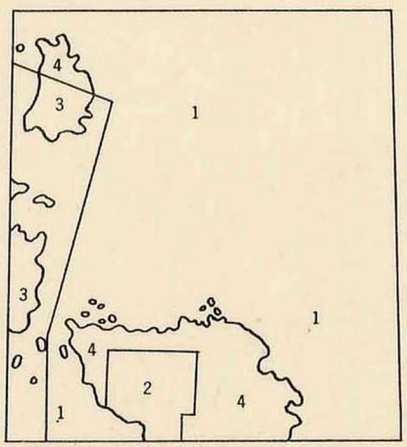
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS



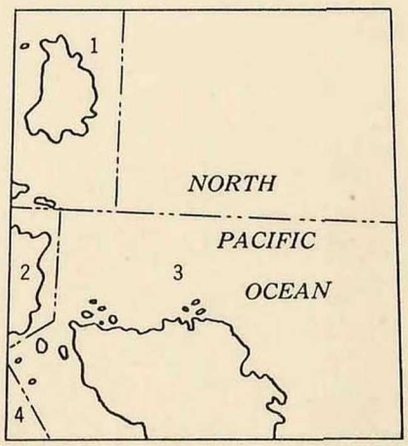
ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090
9-44 1944

COVERAGE DIAGRAM



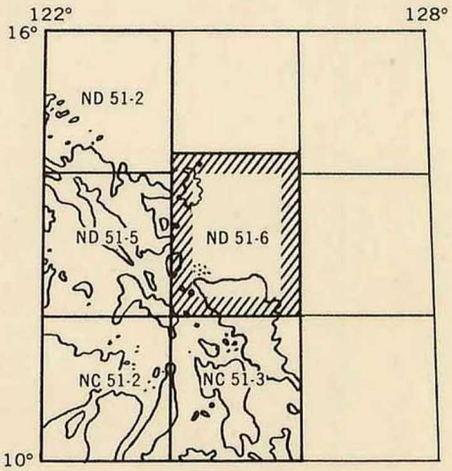
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INDEX TO BOUNDARIES



PROVINCES
1. ALBAY
2. SORSOGOR
3. SAMAR
4. MASBATE

INDEX TO ADJOINING SHEETS



Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

[redacted]

PHILIPPINE ISLANDS 1:500,000

SUGGESTED AIRDROME SITES

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LEYTE ISLAND

SECOND EDITION-AMS 2

SAMAR AND LEYTE (P.I.)

NC 51-3



[redacted]

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Prepared by U. S. GEOLOGICAL SURVEY for CHIEF OF ENGINEERS, U. S. ARMY

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles
10 8 6 4 2 0 10 20 30 Kilometers
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

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- Mud Flat, Tidal Flat
- Mangrove

MANILA
DAVAO
Tagum
Peña
Kalan

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 3' INCREASE
Do not use diagram except to obtain numerical value of angles

COVERAGE DIAGRAM

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Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS
N1000-E12400/200

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1 1/2 1944
S-44

46

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HEIGHTS IN FEET AND DEPTHS IN FATHOMS

PHILIPPINE ISLANDS 1:500,000

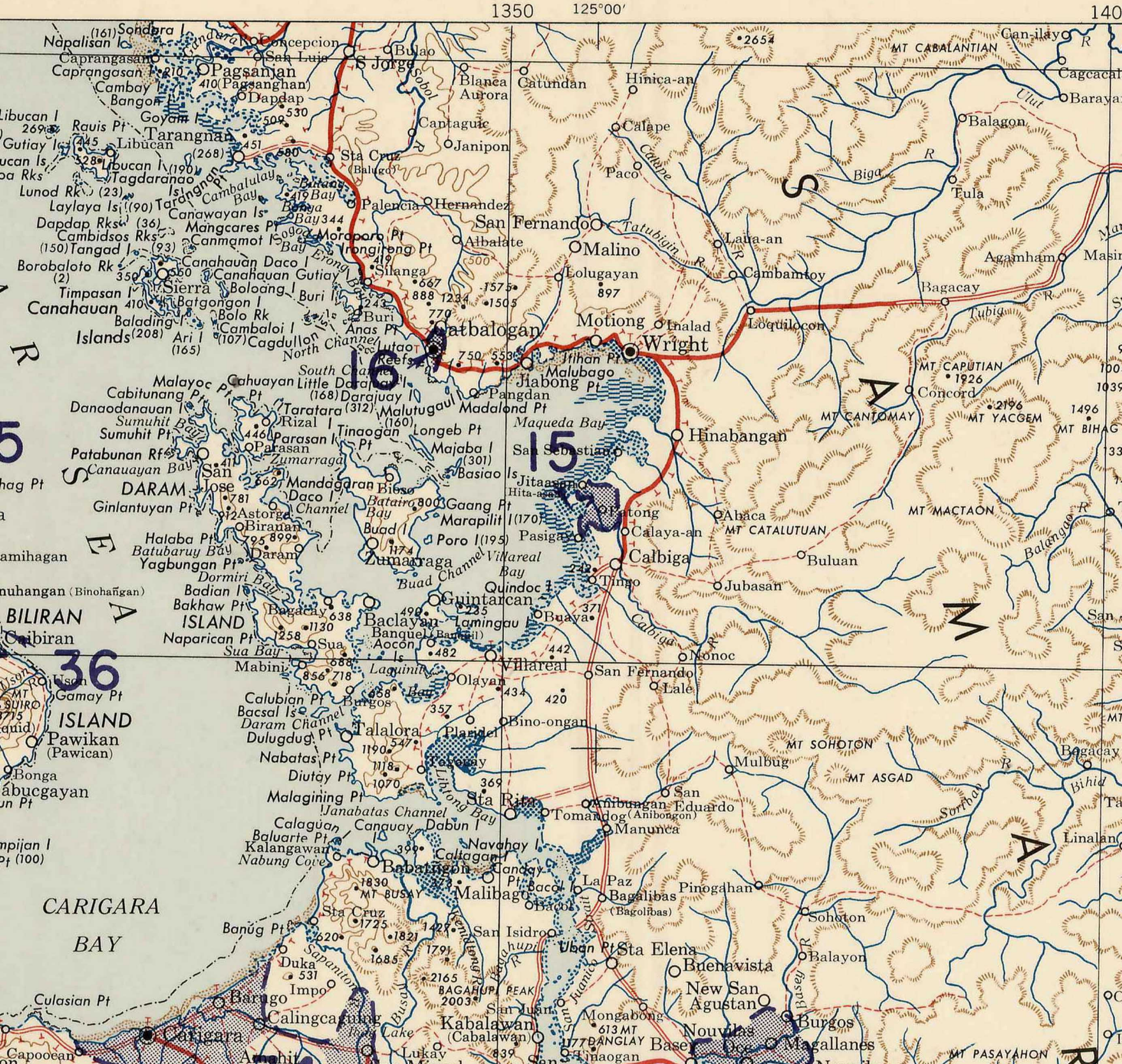
SUGGESTED AIRDROME SITES



[redacted]

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LEYTE ISLAND

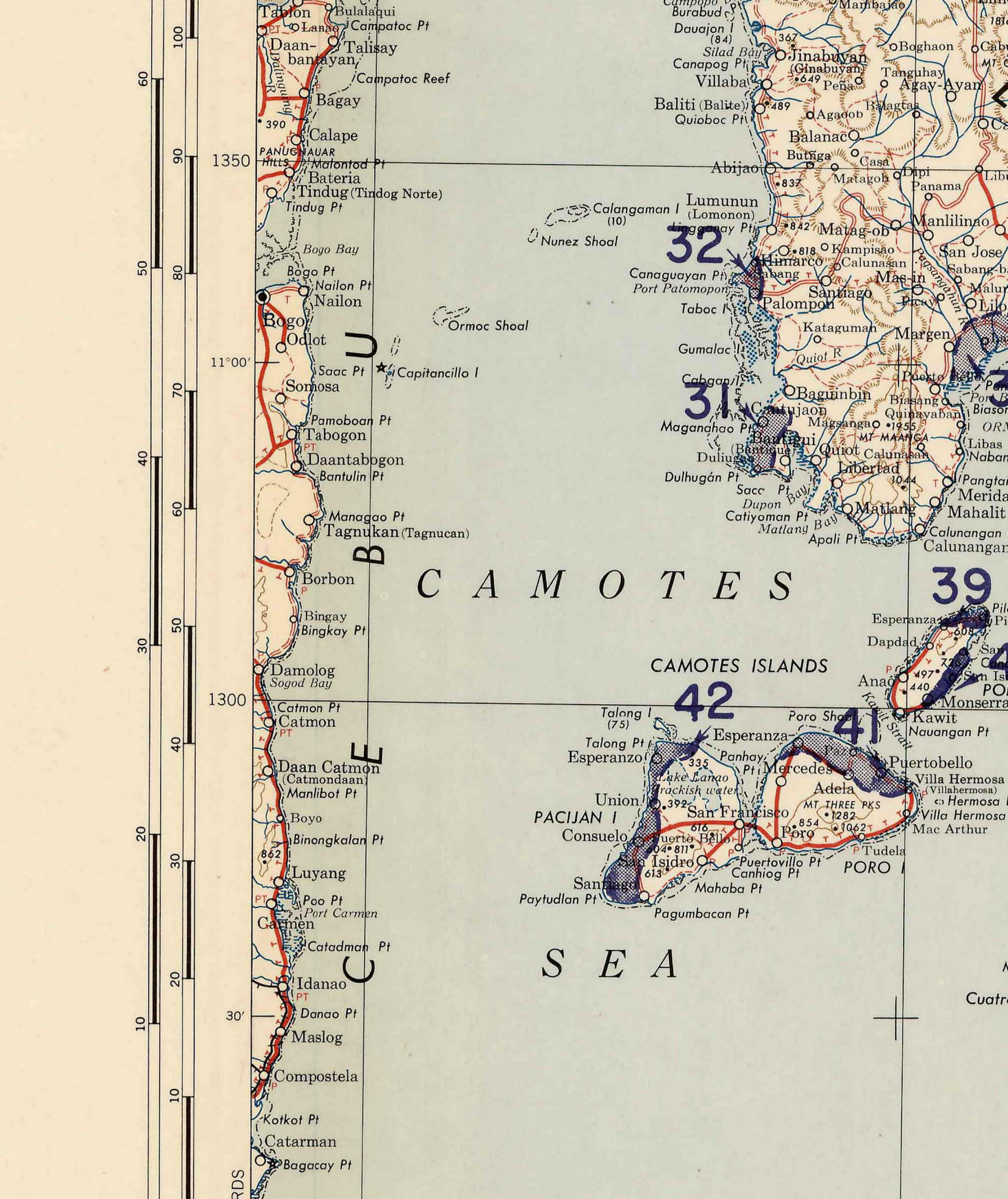


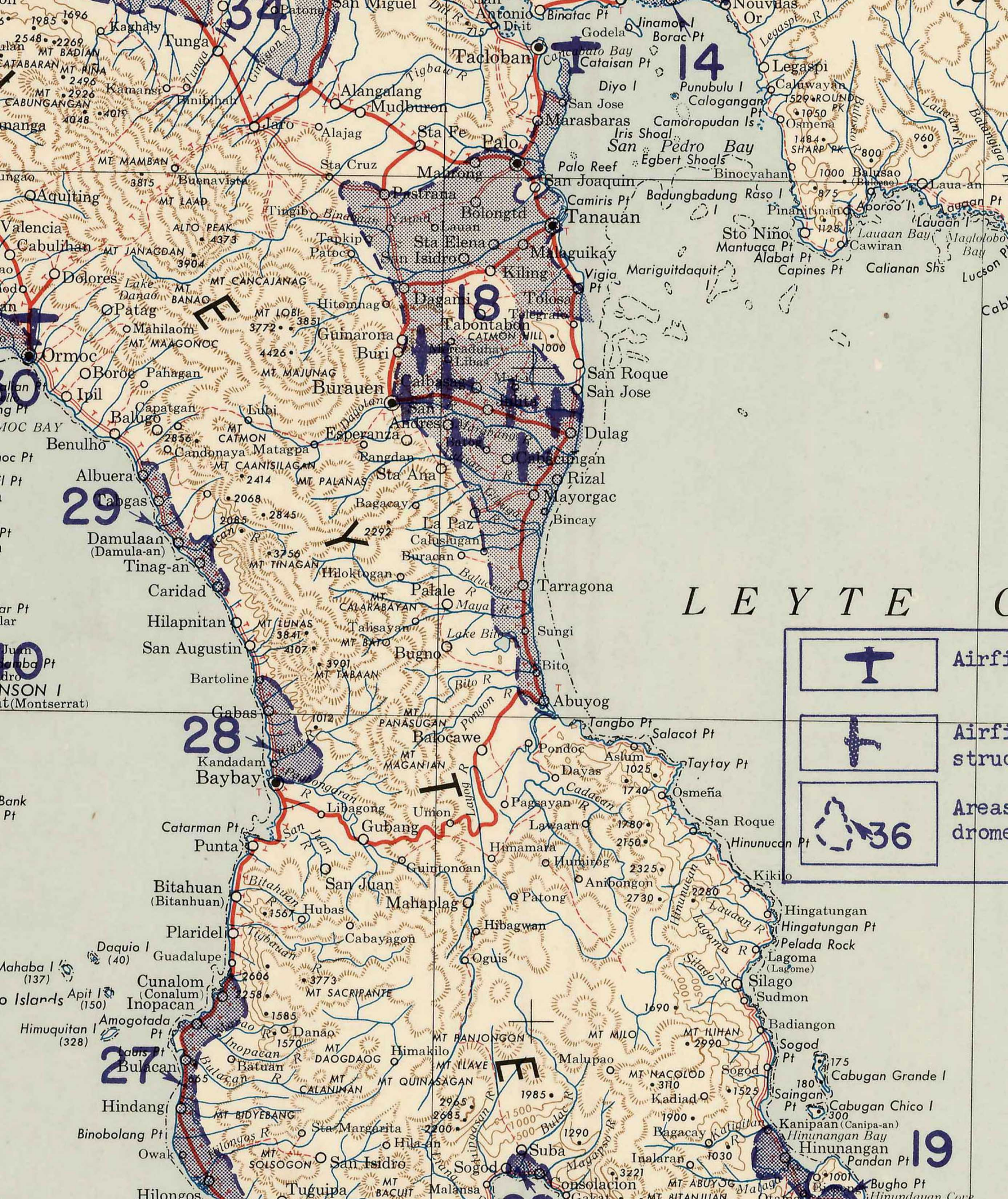
SECOND EDITION-AMS 2

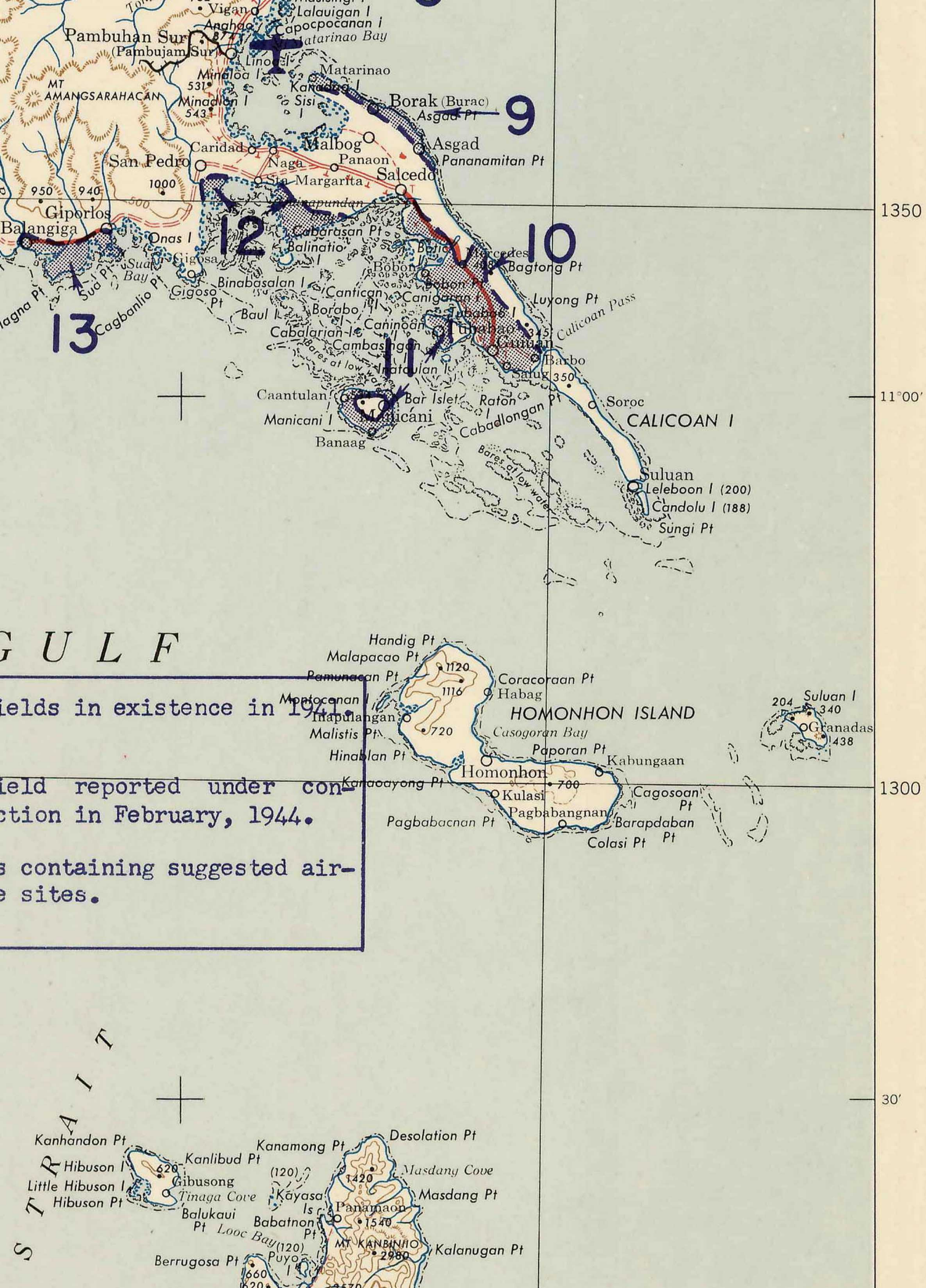
NC 51-3

SAMAR AND LEYTE (P.I.)




Tabon
Bulalaqui
Lanao
Campatoc Pt
Daan-bantayan
Talisay
Campatoc Reef
Bagay
390
Calape
PANUGNAUAR HILLS
Malontod Pt
1350
Bateria
Tindug (Tindog Norte)
Tindug Pt
Bogo Bay
Bogo Pt
Nailon Pt
Nailon
Bogo
Odlot
Ormoc Shoal
11°00'
Saac Pt
Capitancillo I
Somosa
Pamoboan Pt
Tabogon
Daantabogon
Bantulin Pt
Managao Pt
Tagnukan (Tagnucan)
Borbon
Bingay
Bingkay Pt
Damolog
Sogod Bay
1300
Catmon Pt
Catmon
Daan Catmon (Catmondaan)
Manlibot Pt
Boyo
Binongkalan Pt
862
Luyang
Poo Pt
Port Carmen
Carmen
Catadman Pt
Idanao
30'
Danao Pt
Maslog
Compostela
Kotkot Pt
Catarman
Bagacay Pt
CAMOTES SEA
CAMOTES ISLANDS
Burabud
Dauajon I (84)
Silad Bay
Canapog Pt
Villaba
Jinabuyan (Ginabuyan)
649
Peña
Boghaon
Tanguhay
Agay-Ayan
Baliti (Balite)
489
Quioboc Pt
Agaoob
Balagtas
Balanac
Butnga
Casa
Abijao
837
Matagob
Dipi
Panama
Calangaman I (10)
Nunez Shoal
Lumunun (Lomonon)
Linggangay Pt
842
Matag-ob
Manlilinao
San Jose
32
818
Kampisao
Himarco
Calunasan
Canaguayan Pt
Port Patomopon
Mas-in
Santiago
Palompon
Taboc I
Kataguman
Margen
Gumalac
Quiot R
Cabgan I
31
Baguinbin
Catujaon
Maganahao Pt
Magsanga
1255
MT MAANGA
Bantigui (Bantique)
Quiot
Calunasan
Libas
Duliugan
Dulhugán Pt
Libertad
1044
Sacc Pt
Dupon Bay
Catiyoman Pt
Matlang
Matlang Bay
Apali Pt
Mahalit
Calunangan
39
Esperanza
608
Dapdad
497
440
Anao
Monserrat
Kawit
Nauangan Pt
Kawit Strait
Poro Shoal
42
41
Talong I (75)
Talong Pt
Esperanzo
Esperanza
Panhay Pt
335
Lake Lanao (brackish water)
Mercedes
Puertobello
Villa Hermosa (Villahermosa)
Adela
Union
392
MT THREE PKS
1282
San Francisco
854
1062
Poro
Villa Hermosa
Mac Arthur
PACIJAN I
Consuelo
616
Puerto Bello
804
811
Tudela
San Isidro
613
Puertovillo Pt
Canhiog Pt
PORO I
Santiago
Mahaba Pt
Paytudlan Pt
Pagumbacan Pt

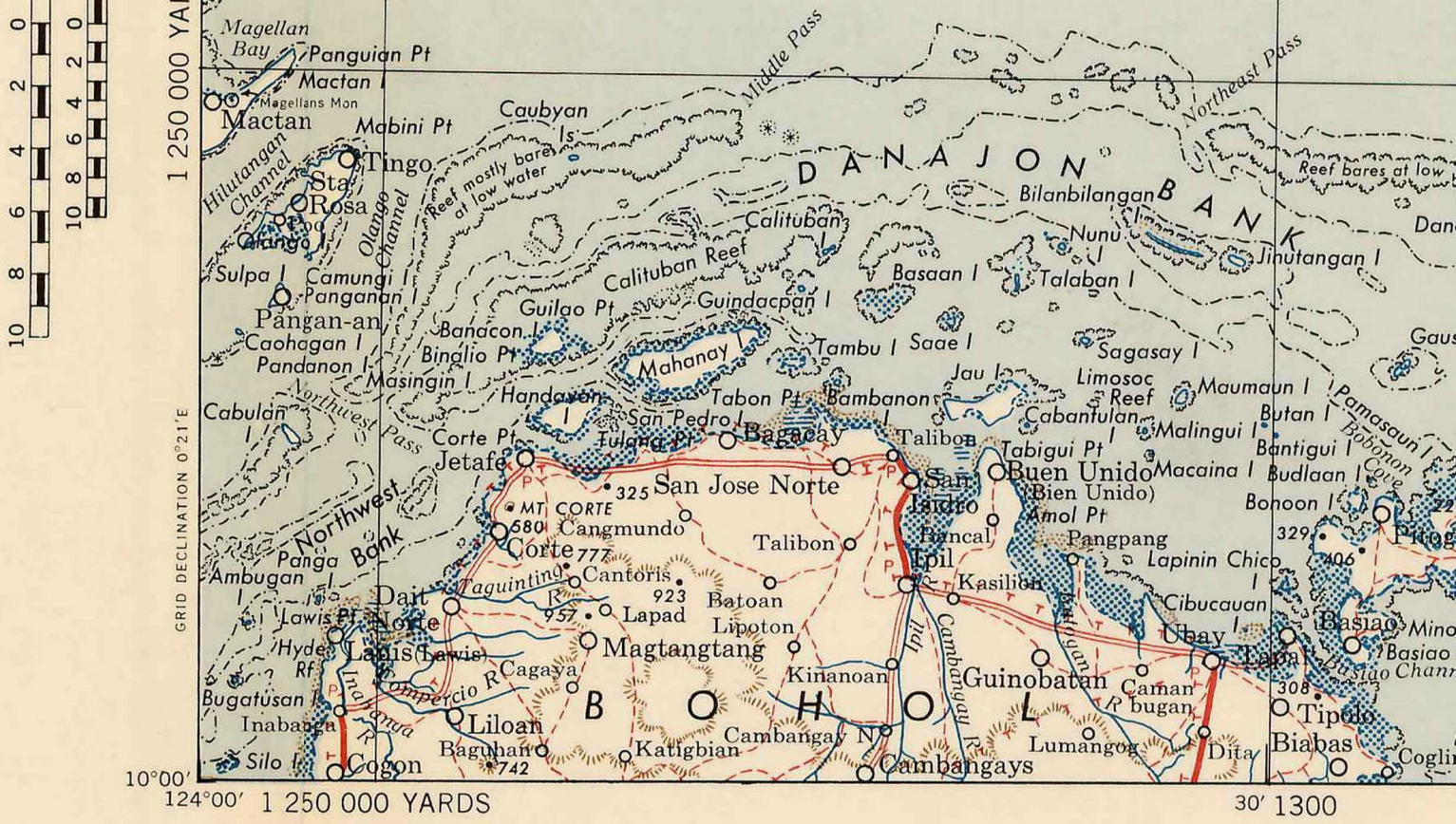

LEYTE
Airfi
Airfi
struc
Areas
drome
36
Tacloban
Tanauan
Palo
Burauen
Baybay
Ormoc
Carigara
Dulag
Abuyog
Hinunangan
Sogod
Bato
Inopacan
Hindang
Bontoc
Hilongos
Tuguipa
Consolacion
Suba
Malitbog
Maasin
Bugho Pt
Hinundayan Cove
Hinunangan Bay
Leyte Gulf
San Pedro Bay
Cataisan Pt
Camiris Pt
Binocyahan
Egbert Shoals
Palo Reef
Iris Shoal
Camoropudan Is
Diyo I
Punubulu I
Calogangan Pt
Legaspi
Caluwayan
Osmeña
Laua-an
Aporoo I
Lauaan I
Lauaan Bay
Maglolobo Bay
Sto Niño
Cawiran
Mantuaca Pt
Alabat Pt
Capines Pt
Calianan Shs
Mariguitdaquit
Vigia Pt
Malaguikay
San Roque
San Jose
Kiling
Tolosa
Dagami
Tabontabon
Guinarona
Buri
Calbasag
Esperanza
Sta Ana
Rizal
Mayorgac
Bincay
La Paz
Tarragona
Sungi
Bito
Lake Bito
Palale
Hiloktogan
Buracan
Caluslugan
Bagacay
Rangdan
Matagpa
Candonaya
Lubi
Capatagan
Pahagan
Boroc
Ipil
Benulho
Albuera
Tabgas
Damulaan
(Damula-an)
Tinag-an
Caridad
Hilapnitan
San Augustin
Bartoline
Gabas
Kandadam
Catarman Pt
Punta
Bitahuan
(Bitanhuan)
Plaridel
Daquio I
(40)
Guadalupe
Cunalom
(Conalum)
Apit I
(150)
Inopacan
Amogotada Pt
Himuquitan I
(328)
Labis Pt
Bulacan
Binobolang Pt
Owak
Libagong
Gubang
Union
Lawaan
Pagsayan
Cadacan
Himamara
Humirog
Guintonoan
San Juan
Mahaplag
Patong
Hubas
Cabayagon
Hibagwan
Oguis
Malupao
Himakilo
Danao
Batuan
Sta Margarita
Hila-an
San Isidro
Sogod
Malansa
Inalaran
Kadiad
Bagacay
Suba
Kanipaan
(Canipa-an)
Saingan Pt
Cabugan Grande I
Cabugan Chico I
Badiangon
Sudmon
Silago
Lagoma
(Lagome)
Pelada Rock
Hingatungan Pt
Hingatungan
Kikilo
Hinunucan Pt
San Roque
Taytay Pt
Osmeña
Aslum
Dayas
Pondoc
Salacot Pt
Tangbo Pt
Balocawe
Abuyog
Bito
Tarragona
Dulag
Binocyahan
Sto Niño
Tanauan
Palo
Tacloban
Kaghaly
Tunga
Alangalang
Mudburon
Jaro
Alajag
Sta Fe
Marasbaras
San Joaquin
Pastrana
Malirong
Sta Cruz
Buenavista
Aquiting
Valencia
Cabulihan
Dolores
Patag
Mahilaom
Ormoc
Lake Danao
MT CANCAJANAG
MT LOBI
MT MAAGONOC
MT JANAGDAN
MT LAAD
MT MAMBAN
MT BANAO
ALTO PEAK
MT CATMON
MT CAANISILAGAN
MT PALANAS
MT TINAGAN
MT CALAHABAYAN
MT LUNAS
MT BATO
MT TABAAN
MT PANASUGAN
MT MAGANIAN
MT SACRIPANTE
MT DAOGDAOG
MT CALANUNAN
MT QUINASAGAN
MT BIDYEBANG
MT SOLSOGON
MT BACUIT
MT RANJONGON
MT ILAVE
MT MILO
MT ILIHAN
MT NACOLOD
MT ABUYOG
MT BITANJUAN
CATABARAN
CABUNGANGAN
MT BADIAN
MT HINA
Tunga R
Cinigan R
Tigbao R
Binahaan
Tapikip
Patoc
Lauan
Tingib
Dit R
Legaspi R
Lauaan R
Balusao
Laua-an
Camiris Pt
Badungbadung Raso I
Pinanitinan
Aporoo I
Lauaan I
Lauaan Bay
Maglolobo Bay



ields in existence in 1941.

ield reported under con-
ction in February, 1944.

s containing suggested air-
e sites.



A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D.

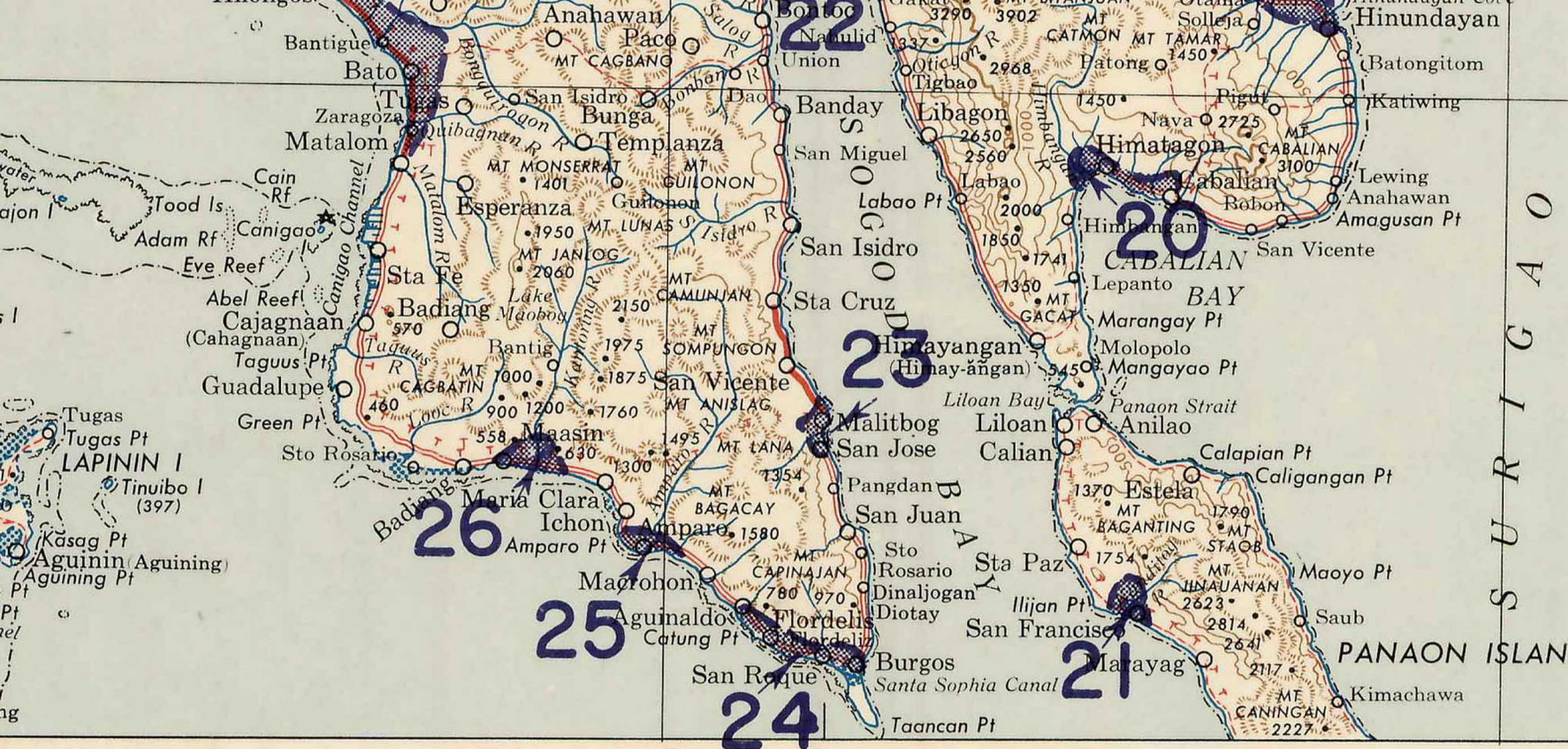
Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 19 1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippine 1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map of Samar Island, 1:63,360, O. C. E. O., Phil. Div., No. 1, 1908. Standard Recon. Map, Surigao & Augusan, 1:100,000, Inc. Co., No I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road M P. I., 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road M Philippines, 1:500,000, Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Hq Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, U No. 100, 1933.

CONVERSION GRAPH
NOT at the scale of the map.

Meters: 3,000 2,500 2,000 1,500 1,000 500 0
Feet: 10,000 9,000 8,000 7,000 6,000 5,000 4,000 3,000 2,000 1,000 0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3′6″ gauge; with Station
- Railroad, Less than 3′6″ gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove



PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

10000 0 10000 20000 30000 Yards

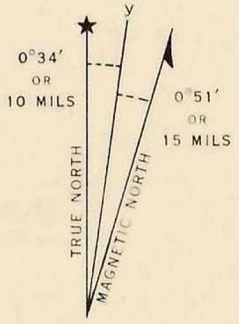
CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS WASHINGTON, D. C.

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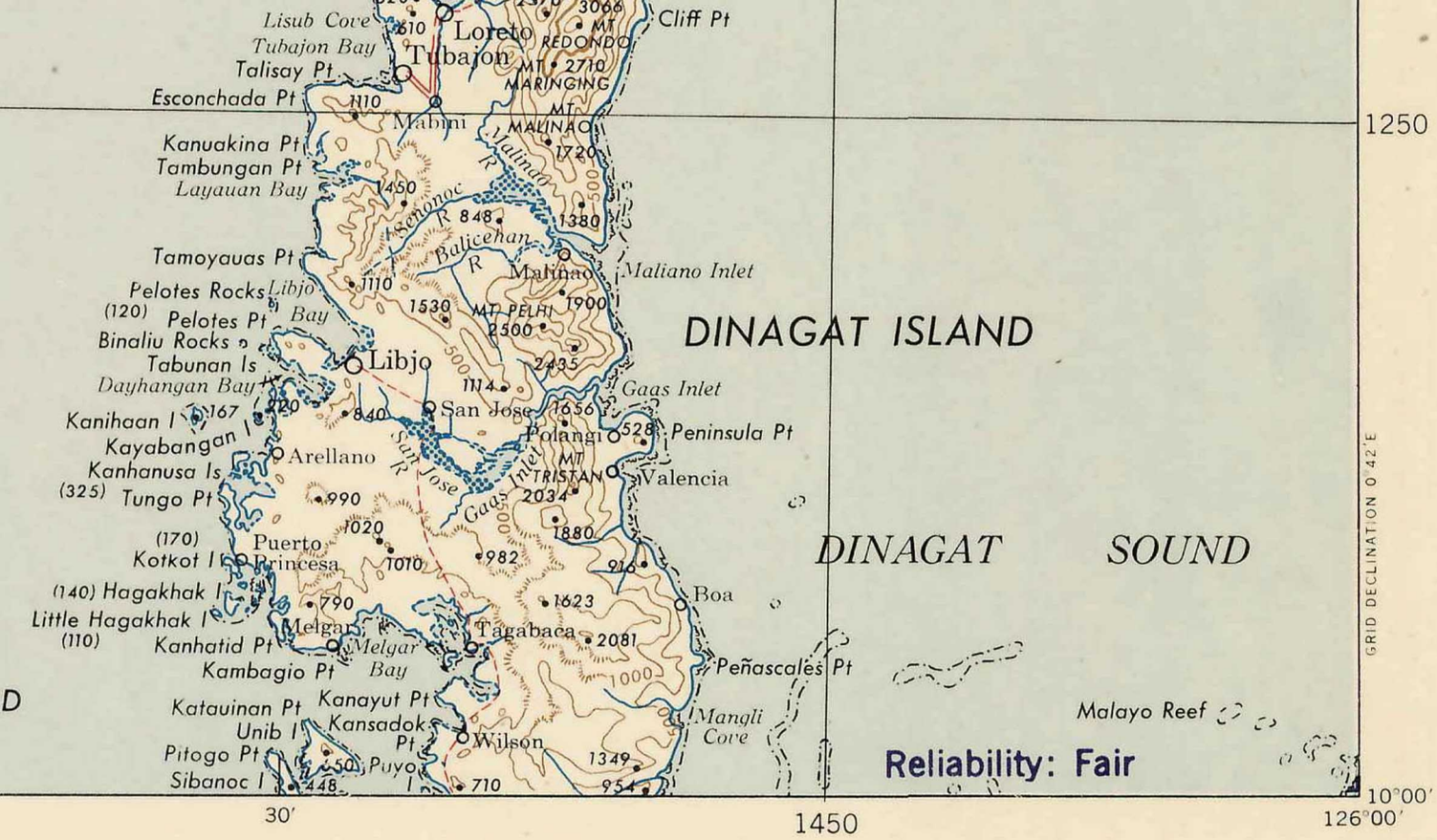


APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

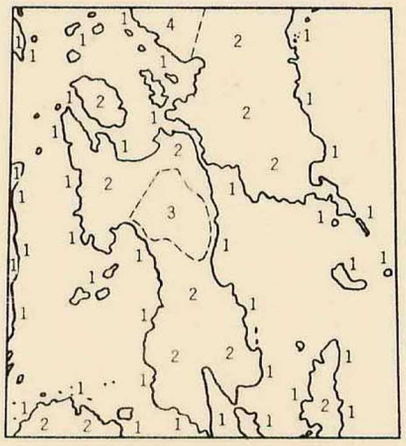
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS

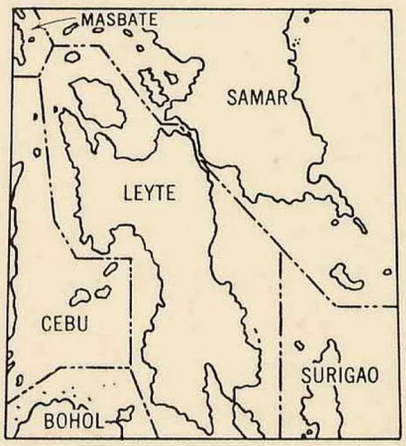


ARMY MAP SERVICE, U S ARMY, WASHINGTON D. C. 112094
9-44 1944

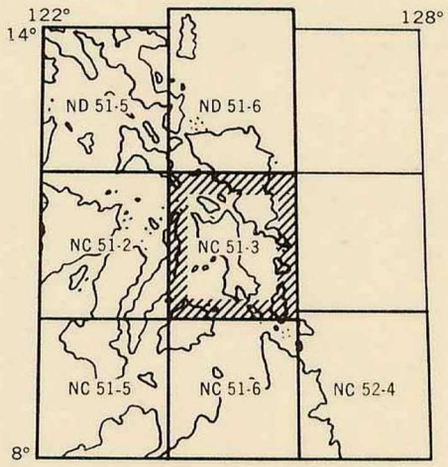
COVERAGE DIAGRAM



INDEX TO BOUNDARIES



INDEX TO ADJOINING SHEETS



1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

Reliability: Fair.

Specific reliability given for each major topic discussed under airdrome sites in text.

Introduction

Topography: The 42 areas outlined on the index map of Samar and Leyte Islands are, without exception, on coastal plains, deltaic flats, or lowland plains. Areas 1-17 are on Samar and adjacent islands; areas 18-42 are on Leyte and adjacent islands. Most are on the coast and less than 50 feet above sea level. All the areas are evaluated in the accompanying summary tabulation, but only areas that are reasonably accessible and which are topographically good or fair are discussed in detail. Detailed maps were available for a number of areas which, for reasons of topography or accessibility, are somewhat unfavorable; these maps are reproduced, with little or no discussion, because of possible value in locating emergency fields. A few accessible areas that seem suitable for airdrome sites are not discussed further because of lack of information.

Most of the information on topography was taken from the U. S. Coast and Geodetic Survey coast charts (which generally show the topography for one to three miles inland) supplemented by a few photographs, local descriptions given in ONI reports, and some descriptions from the Coast Pilot. Many of the charts reproduced here are from photographs of the original data sheets of the Coast and Geodetic Survey; some show 50-foot contours, with a scale of 1:20,000, as compared with the published 1:100,000 maps with a 100-foot contour interval. An explanation of the vegetation symbols on the maps accompanies text. Some areas, for which the only maps available had a contour interval of 100 feet, may have considerable local relief not indicated on the map. The outlined areas should be regarded as merely delimiting sections in which further reconnaissance might locate feasible sites.

Evaluation of Data: In general, the basic data which governed the valuation of the sites are either scanty, poor, or both. This is particularly true for "Soil", "Ease of Clearing", "Drainage", and "Availability of Construction Materials", shown in accompanying Summary Tabulation. The lack of agreement between the excerpts from the detailed coast charts and the more recent but smaller scale map showing vegetation (see Vegetation Sheet) may be due to several factors: 1) The charts were made from 1900 to 1905 and many areas that were in cultivation at that time may be now covered with cogon grass or brush. 2) New areas brought under cultivation since 1905 may be shown on the older charts as "timber" or "brush". 3) The vegetation map shown in Vegetation Sheet, because of its small scale, is of necessity generalized. Areas shown as "cultivated" include patches of brush, cogon grass, and secondary timber.

Construction Problems: Most areas are topographically favorable for airdrome sites, and grading problems are relatively minor. Many of the areas would require extensive clearing of coconut palms, brush, and second-growth timber, but it is unlikely that much clearing will be encountered that cannot be handled with dozers. In many of the areas drainage will be difficult, because of impermeable soil, low surface gradients, and high water table. Most commonly, the seaward side of the coastal plains are underlain by sandy soil which has better drainage and higher bearing strength than soil of the landward side. The inner part of the coastal plains, some of the deltaic flats, and some of the interstream areas of the northeast lowland of Leyte are generally underlain by poorly drained silty or clayey soil, most commonly planted in rice paddies. As there is no well-defined dry season on the islands, this ground probably remains somewhat wet and sticky for the greater part of the year, although during occasional dry spells these flat, cleared areas could be used as emergency landing fields. All of the areas near streams are probably subject to periodic flooding, and coastal areas may be inundated during heavy storms.

Water Supply: Water from either surface or underground sources is obtainable at all the suggested sites. Surface water is available at most sites from nearby perennial streams, but commonly must be transported or piped a mile or more to the site. In general, shallow ground water is the preferable source, and at all sites can be obtained from depth of a few feet. See Water Supply Sheets for additional water data.

Existing Airfields: In 1941, there were seven airfields on Samar and Leyte Islands, as follows:

Catarman: (Area 1) Field located just northwest of the town of Catarman, north coast of Samar, One runway, oriented NE, size: 2750 by 300 feet. Could be readily expanded.

Borongan: (Area 7) Field located one mile east of town of Borongan, on the east coast of Samar. Runway oriented NE, 2,350 by 100 feet. Expansion possible; would involve leveling of low hill (less than 50 feet high). Runway being paved in 1941; not completed.

Anahao: (Not discussed in text.) On Anahao Island, in Matarinao Bay, on the southeast coast of Samar. Single runway, N-S, 1,965 by 75 feet, built partly over mangrove swamp. Was not being maintained. Very poor site, could not be expanded.

Calbayog: (Area 17) Near the village of Trinidad, four miles west of Calbayog, on the west coast of Samar. Two runways, NE and NW, each 2,624 by 164 feet, under construction in 1941 (near completion).

Tacloban: (Area 18, Tanauan) On Cataisan Pt, about two miles southeast of town of Tacloban, on the northeast coast of Leyte. Two runways, each 2,700 by 300 feet, oriented N-S and northeast. Good site, but present runways can not be greatly expanded.

Ormoc: (Area 30) Location given as 4 miles NW of Ormoc. Runway NE, 4,950 by 396 feet, subject to serious flooding; had developed soft spots. Some further work reported being done on field by Japanese.

Hinundayan: (Area 19, Hinunangan) One strip, 1,640 by 130 feet. No further information. On east cost of Leyte Island, emergency landing field reported but no further information available.

Airfields Under Construction: In February 1944, seven airfields were reported to be under construction in Area 18 (Tanauan) on the northeast lowland of Leyte. Approximate locations are shown by symbol on accompanying maps.

SUMMARY TABULATION OF AIRDROME SITE DATA

AREA	Accessibility	Topography	Drainage	Soil	Water Supply	Availability of Construction Materials	Ease of Clearing
***1 (Catarman)							
***2 (Mondragon)							
***3 (Livas Point)							
*4 (Laong)							
***5 (Dolores)							
***6 (San Julian)							
***7 (Borongan)							
*8 (Hernani)							
*9 (Borok)							
***10 (Guiuan)							
**11 (Manicani)							
*12 (Cabarasan)							
*13 (Cablanga)							
***14 (Bas y)							
**15 (Calbiga)							
**16 (Catbalogan)							
***17 (Calbayog)							
***18 (Tanauan)							
***19 (Hinunangan)							
*20 (Cabalian)							
**21 (San Francisco)							
**22 (Sogod)							
**23 (Malitbog)							
***24 (San Roque)							
**25 (Amparo)							
**26 (Maasin)							
***27 (Hindang)		?	?	?			
**28 (Baybay)		?	?	?			
*29 (Albuera)		?	?	?			
*30 (Ormoc)			(1)	(2)			
*31 (Duljugan)							
***32 (Canaguayan)							
*33 (Leyte)							
***34 (Carigari)							
***35 (Bohol)							
***36 (Caibiran)							
***37 (Biliran)							
***38 (Naval)							
***39 (North Ponson)							
***40 (East Ponson)							
***41 (Poro)							
***42 (Pacijan)							

Good Fair Poor

*** Area discussed in detail in text, with detailed map or photograph.

** Area discussed only briefly in text, with detailed map only.

* Area summarized in this table only. Not discussed in text.

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

Reliability: Fai

Specific reliability given for ea
under airdrome sites in text.

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AREA	
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***2	(Mondragon)
***3	(Livas Point)
*4	(Laong)
***5	(Dolores)
***6	(San Julian)
***7	(Borongan)

SUGGESTED AIRDROME SITES

UMMARY TABULATION OF AIRDROME SITE DATA

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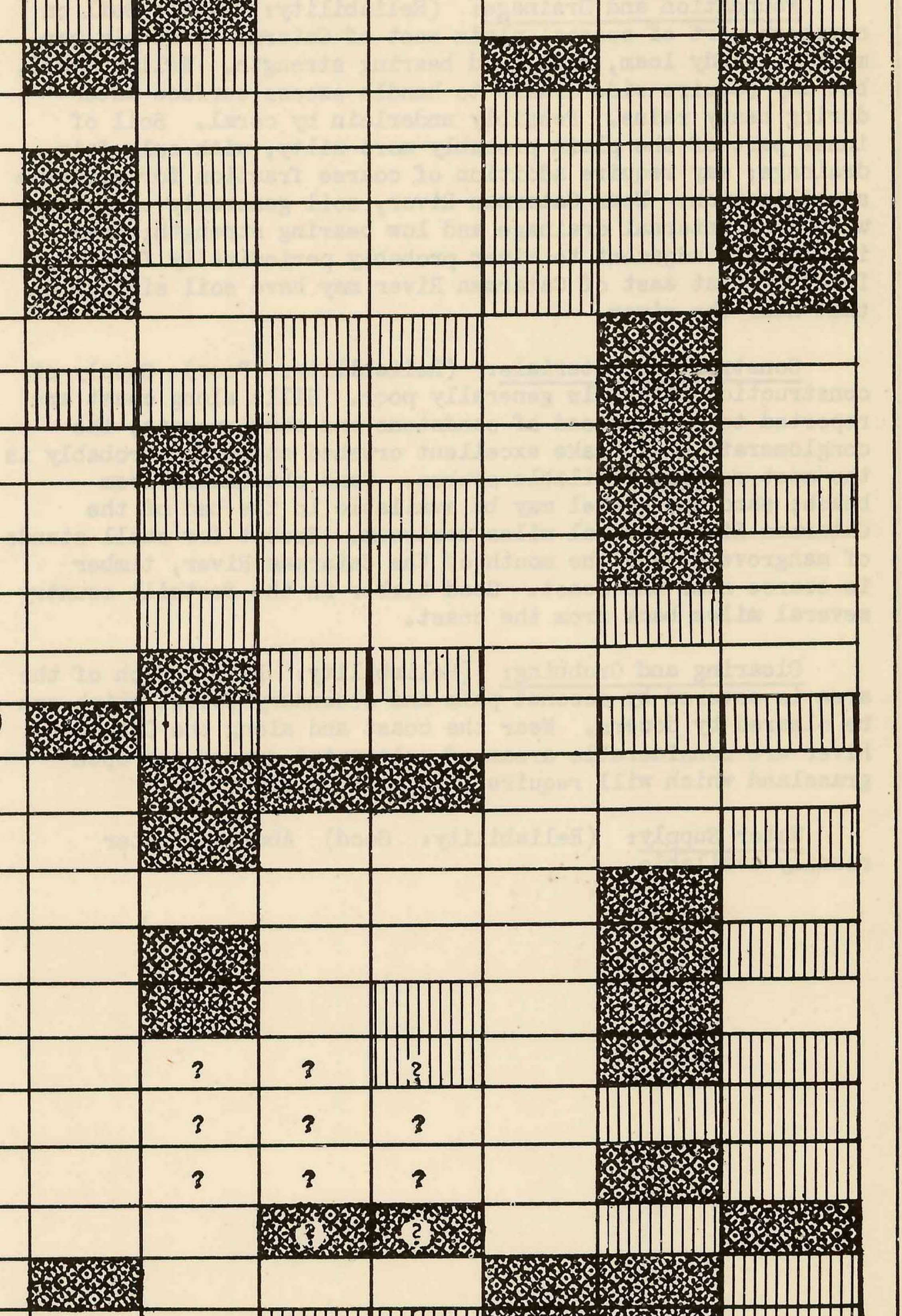
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***41 (Poro)
***42 (Pacijan)

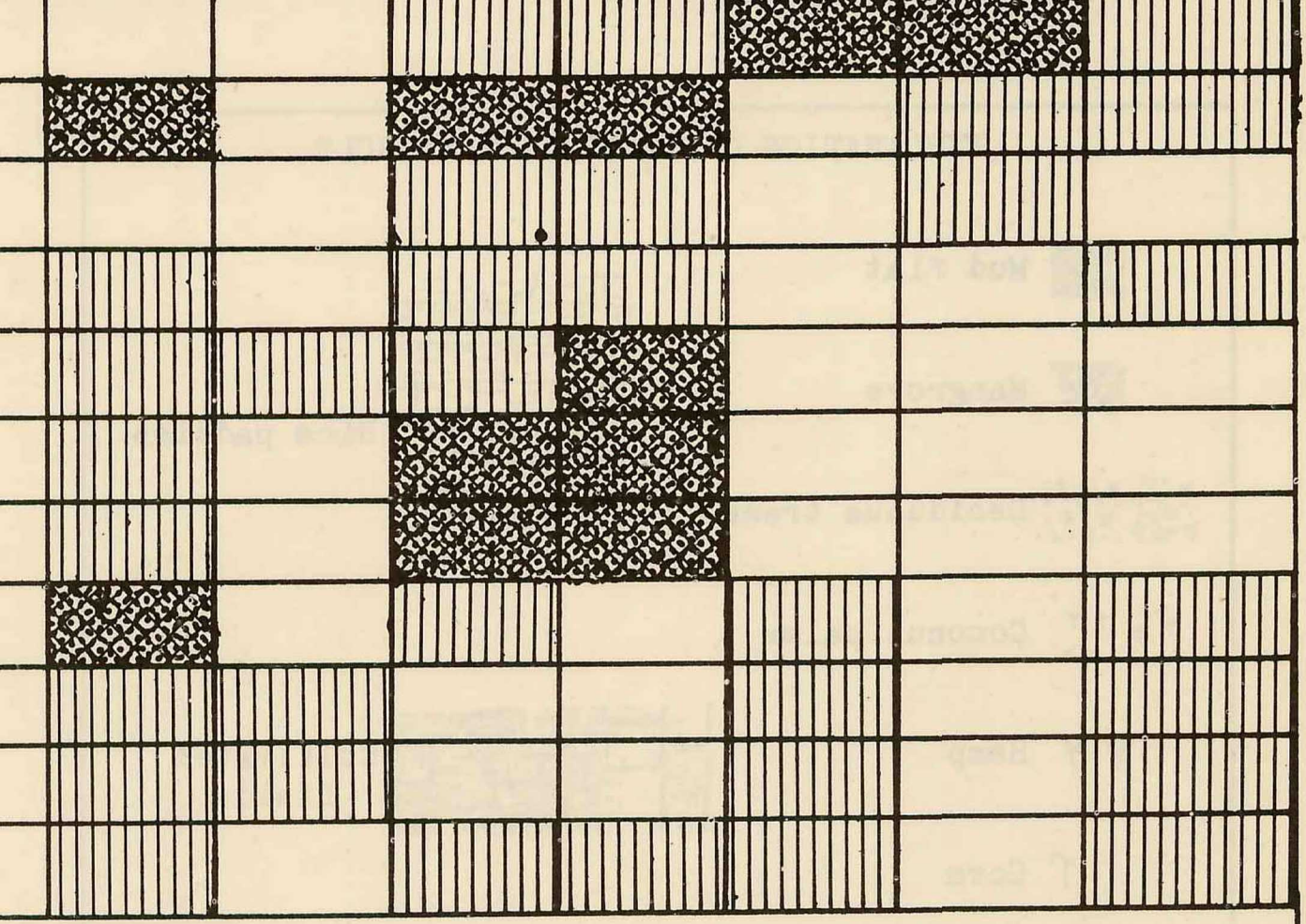
Good ☐

*** Area discuss

** Area discuss

* Area summari

[redacted]



Fair Poor

ed in detail in text, with detailed map or photograph.

ed only briefly in text, with detailed map only.

zed in this table only. Not discussed in text.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

AREA 1 (CATARMAN)

Summary Evaluation: Generally favorable. Small field at Catarman could be expanded to fighter field; other parts of area suitable for bomber fields parallel to coast.

Location and Accessibility: North coast of Samar, on the coastal and deltaic flat near the town of Catarman. Located at the junction of the north coastal road with the interior road from Calbayog on the west coast. No port facilities, but excellent sand beach. Small landing field in existence in 1941 northwest of Catarman (see view) with a 2,750 by 300 foot runway oriented northeast.

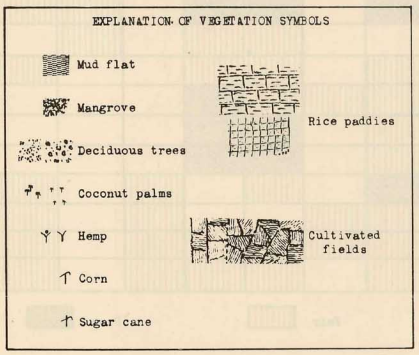
Topography and Grading: (Reliability: Good) Extensive flat area, approximately two by eight miles, bounded on the south by foothills which rise, with moderate slopes, to elevations of not over 500 feet. A series of low hills, 25 - 100 feet in height (probably many not shown on map), extends along the coast and locally may obstruct approaches from the north. Ample area for runways and dispersal area, with second-growth forest or coconut palms for concealment. The field in existence in 1941 could be readily expanded but would have obstructed approach from south. Essentially unobstructed approaches for runways oriented east, throughout the area. Selected sites will give unobstructed approach from the north, but inland approaches will generally be limited. Little grading necessary except possibly for removal of approach obstacles close to coast.

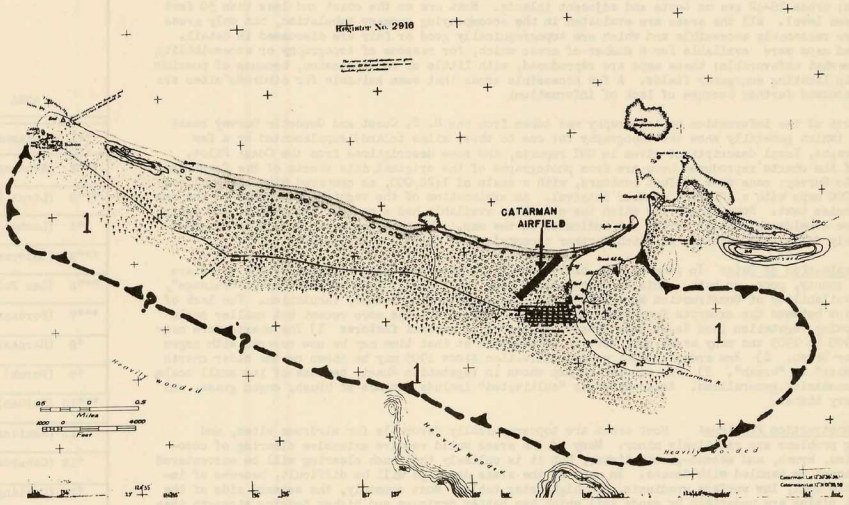
Foundation and Drainage: (Reliability: Fair) Soil on northern part of coastal plain west of Catarman probably permeable, sandy loam, with good bearing strength. Well-drained, but may require side drains to handle excess surface water during heavy rains. Possibly underlain by coral. Soil of inner part of the plain probably more silty, with only fair drainage; may require addition of coarse fraction for subgrade stabilization. Near Catarman River, soil generally clay loam with poor internal drainage and low bearing strength; area immediately adjacent to river probably periodically flooded. Interior flat east of Catarman River may have soil similar to that near the river.

Construction Materials: (Reliability: Poor) Supply of construction materials generally poor. Hills along coast are reported to be composed of sandstone and conglomerate; the conglomerate would make excellent crushed stone and probably is the most readily available source. Sand obtainable from beach; sand and gravel may be available in the bed of the Catarman River several miles upstream. Except for small stands of mangrove around the mouth of the Catarman River, timber is scarce near the coast. Good timber in the foothill country several miles back from the coast.

Clearing and Grubbing: (Reliability: Fair) Much of the area is covered by coconut palm and secondary forest which can be cleared by dozers. Near the coast and along the Catarman River are considerable areas of cultivated ground and open grassland which will require little or no clearing.

Water Supply: (Reliability: Good) Abundant water readily available.





AREA 1 (CATARMAN)

Contour Interval 50 feet



Airfield at Catarman, Samar. (AREA 1). View to east. 1939. (A. C. 20461)

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

SUGGESTED AIRDROME SITES

AREA 1 (CATARMAN)

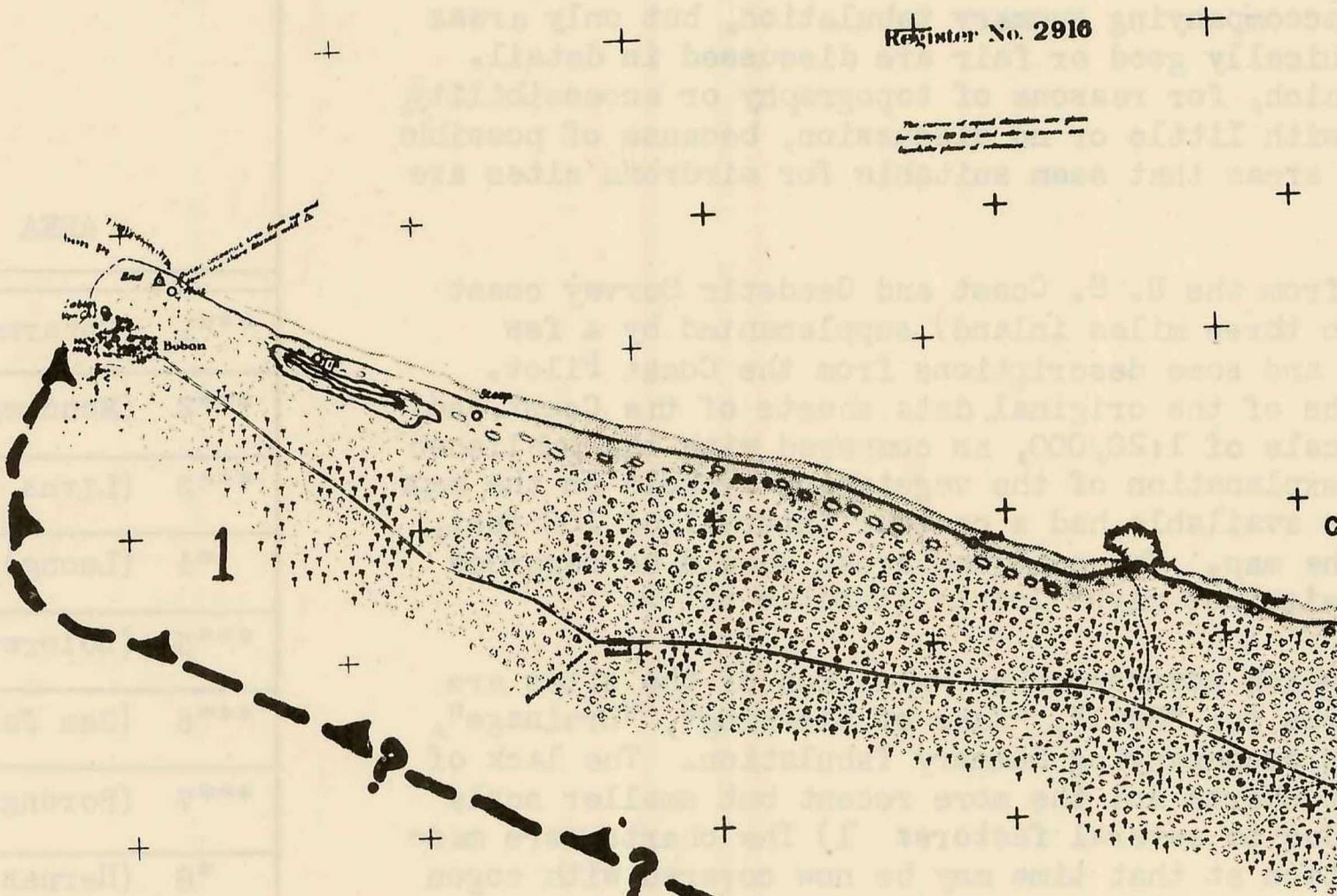
Summary Evaluation: Generally favorable. Small field at Catarman could be expanded to fighter field; other parts of area suitable for bomber fields parallel to coast.

Location and Accessibility:
North coast of Samar, on the coastal and deltaic flat near the town of Catarman. Located at the junction of the north coastal road with the interior road from Calbayog on the west coast. No port facilities, but excellent sand beach. Small landing field in existence in 1941 northwest of Catarman (see view) with a 2,750 by 300 foot runway oriented northeast.

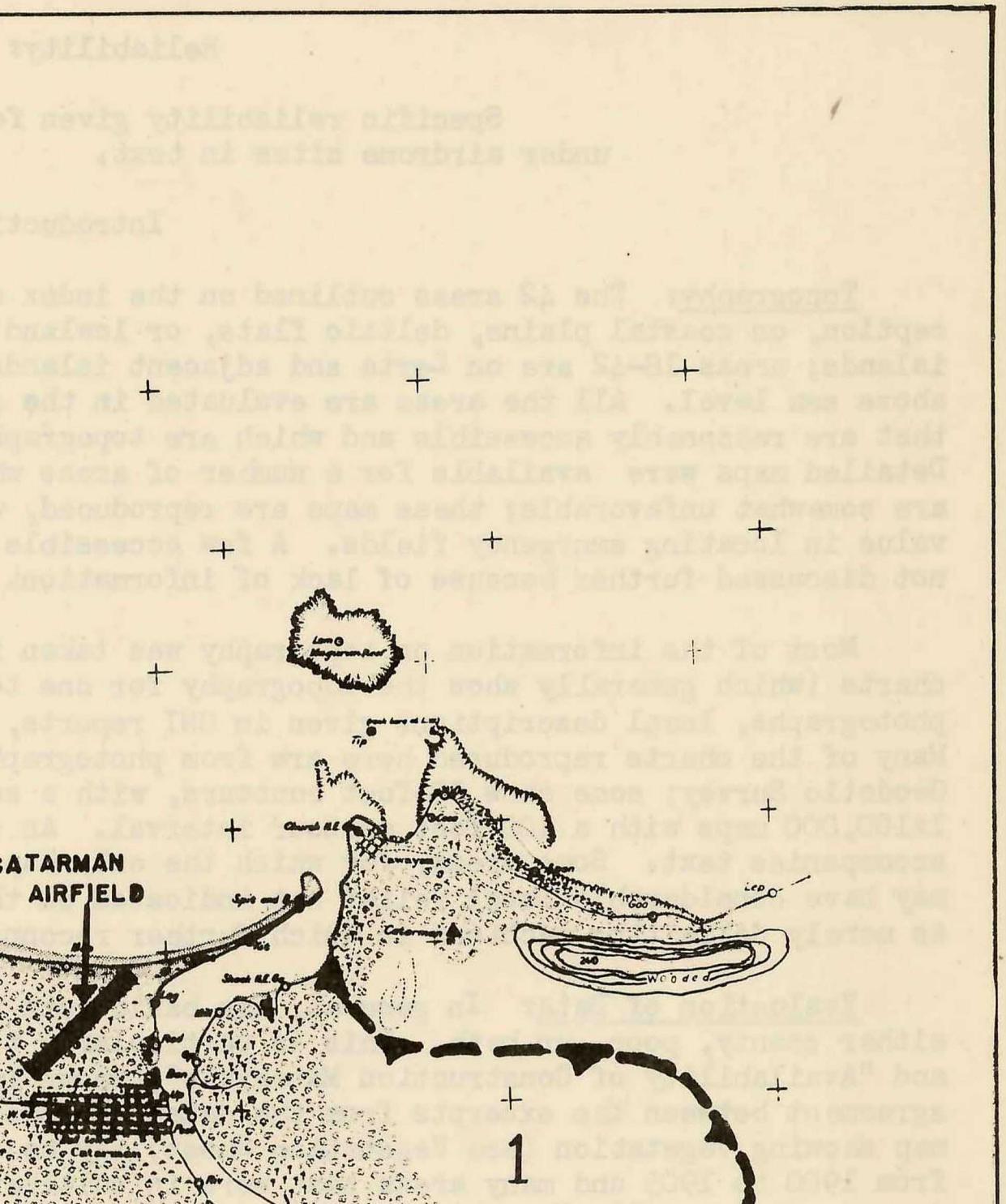
Topography and Grading: (Reliability: Good) Extensive flat area, approximately two by eight miles, bounded on the south by foothills which rise, with moderate slopes, to elevations of not over 500 feet. A series of low hills, 25 - 100 feet in height (probably many not shown on map), extends along the coast and locally may obstruct approaches from the north. Ample area for runways and dispersal area, with second-growth forest or coconut palms for concealment. The field in existence in 1941 could be readily expanded but would have obstructed approach from south. Essentially unobstructed approaches for runways oriented east, throughout the area. Selected sites will give unobstructed approach from the north, but inland approaches will generally be limited. Little grading necessary except possibly for removal of approach obstacles close to coast.

Foundation and Drainage: (Reliability: Fair) Soil on

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SAMAR AND LEYTE (P.I.)

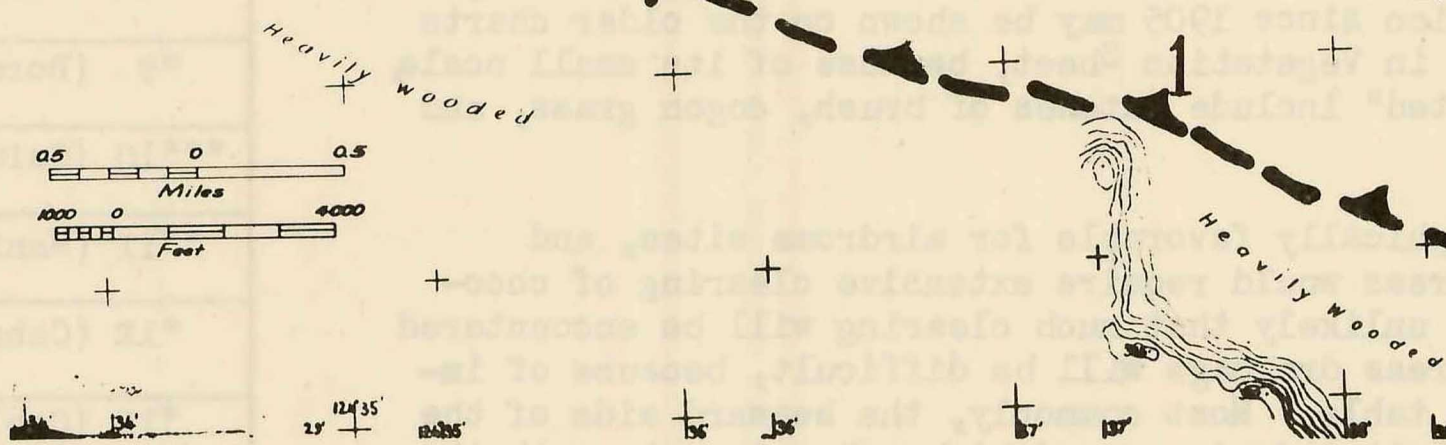


Foundation and Drainage: (Reliability: Fair) Soil on northern part of coastal plain west of Catarman probably permeable, sandy loam, with good bearing strength. Well-drained, but may require side drains to handle excess surface water during heavy rains. Possibly underlain by coral. Soil of inner part of the plain probably more silty, with only fair drainage; may require addition of coarse fraction for subgrade stabilization. Near Catarman River, soil generally clay loam with poor internal drainage and low bearing strength; area immediately adjacent to river probably periodically flooded. Interior flat east of Catarman River may have soil similar to that near the river.

Construction Materials: (Reliability: Poor) Supply of construction materials generally poor. Hills along coast are reported to be composed of sandstone and conglomerate; the conglomerate would make excellent crushed stone and probably is the most readily available source. Sand obtainable from beach; sand and gravel may be available in the bed of the Catarman River several miles upstream. Except for small stands of mangrove around the mouth of the Catarman River, timber is scarce near the coast. Good timber in the foothill country several miles back from the coast.

Clearing and Grubbing: (Reliability: Fair) Much of the area is covered by coconut palm and secondary forest which can be cleared by dozers. Near the coast and along the Catarman River are considerable areas of cultivated ground and open grassland which will require little or no clearing.

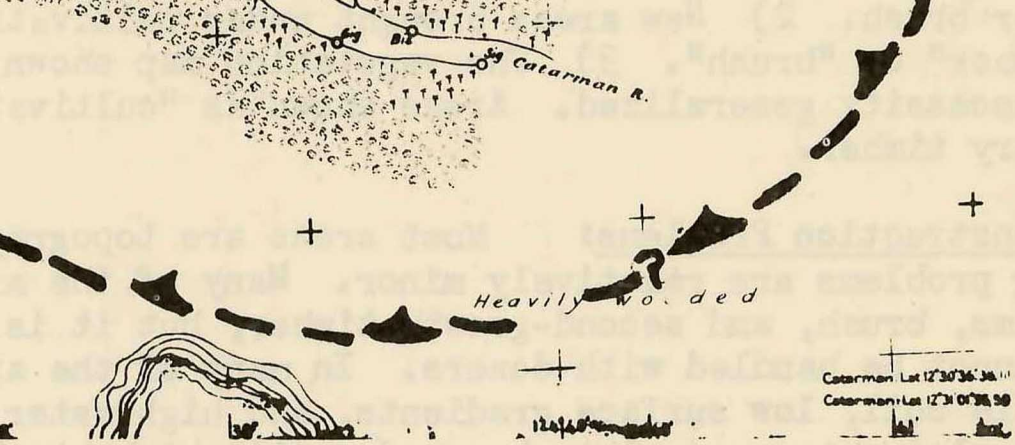
Water Supply: (Reliability: Good) Abundant water readily available.



AREA 1 (CATARMAN)

Contour Interval 50 fee




Big Catarman R.
Heavily wooded
Catarman Lat 12°30'36.36"
Catarman Lat 12°31'01"36.58"



EXPLANATION OF VEGETATION SYMBOLS


Mud flat


Mangrove

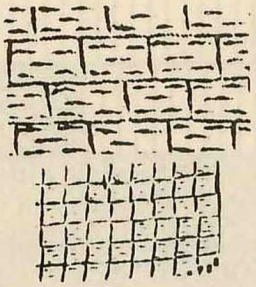

Deciduous trees

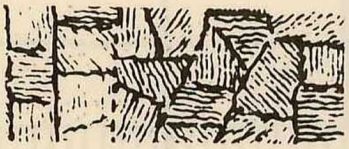

Coconut palms


Hemp


Corn


Sugar cane

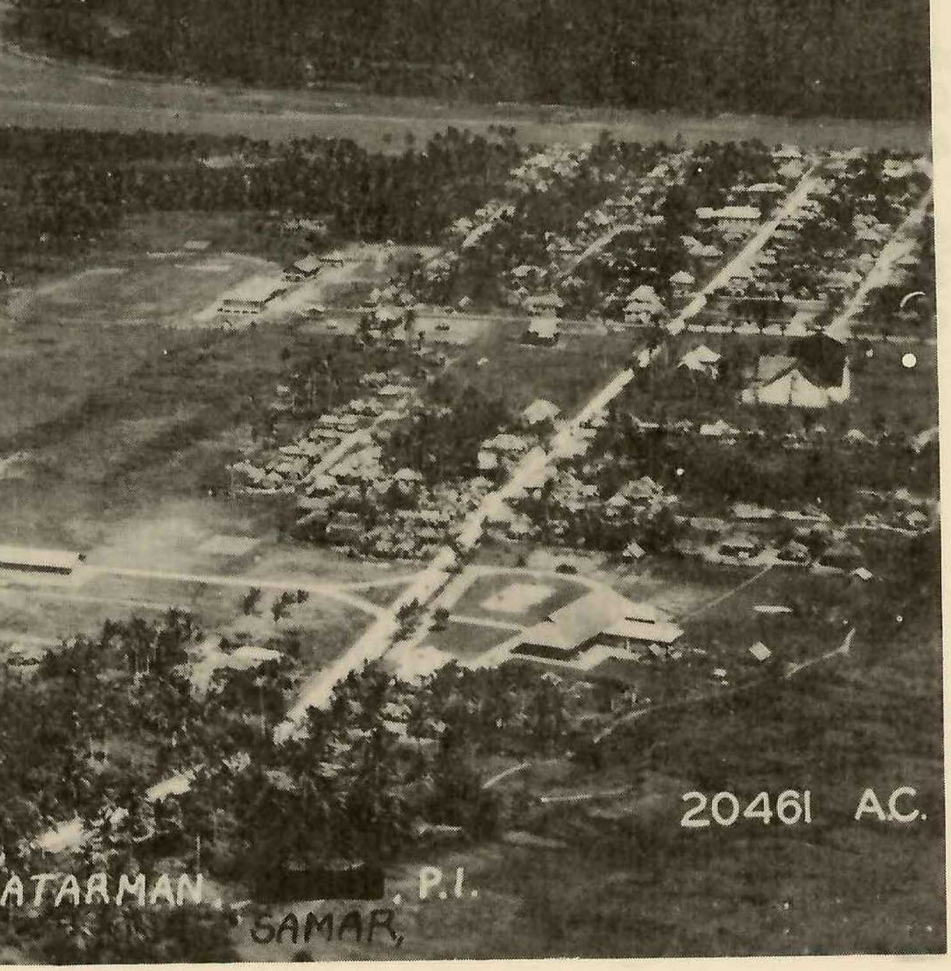

Rice paddies


Cultivated fields



Airfield at Catarman, Samar. (AREA 1). View to e

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ast. 1939. (A. C. 20461)

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 2 (MONDRAGON)

Summary Evaluation: Probably several good or fair sites for bomber fields, but runways generally must be parallel to coast.

Location and Accessibility: Coastal plain on the north coast of Samar, between Mondragon and Pambujan. Coastal road from Catarman passes through the area. Coast mainly sandy beach; in part coral reef. No harbor facilities.

Topography and Grading: (Reliability: Good) Broad coastal flat, approximately 12 by 1 1/2 miles, cut by several large streams; bounded on south by foothills which rise gradually to several hundred feet. Broken coastal ridge, up to 60 feet high, approximately 0.2 mile wide, extends parallel to coast northwest of Bantayan. Ridge continues east of Bantayan but with elevation of less than 40 feet. Hill 73 feet high between Oot Pt. and Paninirongan. Between the low coastal ridge and the foothills are flat, interstream areas large enough for 6,000-foot runways. Approaches will be generally somewhat obstructed from the south and east. North approaches limited because of coastal ridge locally around Bantayan Bay, but in general will be good. Ground relatively flat, with little grading necessary except near streams. Ample space for dispersal areas.

Foundation and Drainage: (Reliability: Fair) In general, soil in the interstream areas near the coast is sandy or silty loam, well drained, with good to fair bearing strength. Back from the coast, near the base of the foothills, silt or clay loams predominate; internal drainage poor; subdrains required before addition of coarse fraction. Areas near streams probably periodically inundated; surface drainage in the interstream areas probably good except during exceptionally heavy rainfall.

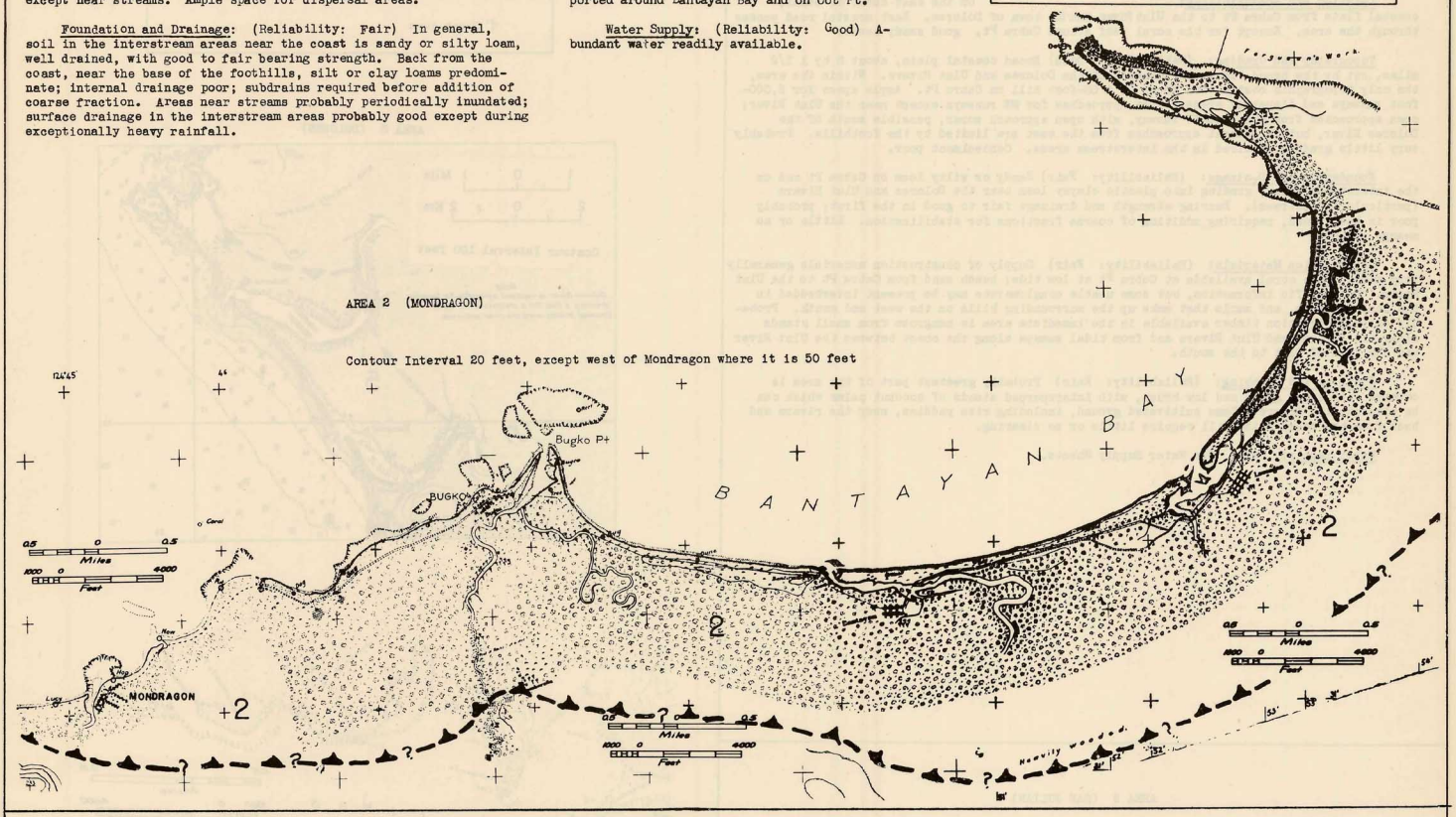
Construction Materials: (Reliability: Fair) Coral reefs, exposed at low tide between Mondragon and Bugko Pt, and on the north side of Oot Pt, will be the best source of construction stone; both localities readily accessible by coast road. Sand available from beach, particularly along Bantayan Bay. Sand and gravel probably available in beds of the streams, two to four miles from coast. Timber available in foothills, back from coast (probably most accessible west of Mondragon); some mangrove on coast between Laoangan and Paninirongan and near Pambujan.

Clearing and Grubbing (Reliability: Fair) Most of area probably either in coconut palm or second growth timber, both of which can be cleared with dozers. Probably considerable areas, particularly along the rivers, will be in field cultivation, and open grassland is reported around Bantayan Bay and on Oot Pt.

Water Supply: (Reliability: Good) Abundant water readily available.

EXPLANATION OF VEGETATION SYMBOLS

Mud flat
Mangrove
Deciduous trees
Coconut palms
Hemp
Corn
Sugar cane
Rice paddies
Cultivated fields



AREA 2 (MONDRAGON)

Contour Interval 20 feet, except west of Mondragon where it is 50 feet

AREA 3 (LIVAS POINT)

Summary Evaluation: Excellent site for quick construction of bomber field. Topography, approaches, and soil good; drainage fair.

Location and Accessibility: A flat, peninsula-like area on the north coast of Samar, extending north from the coastal road between the towns of Pambujan and Burabud. The road provides the best means of access; some sandy beach between coral reefs along the west side of the area. The east side is entirely fringed by coral.

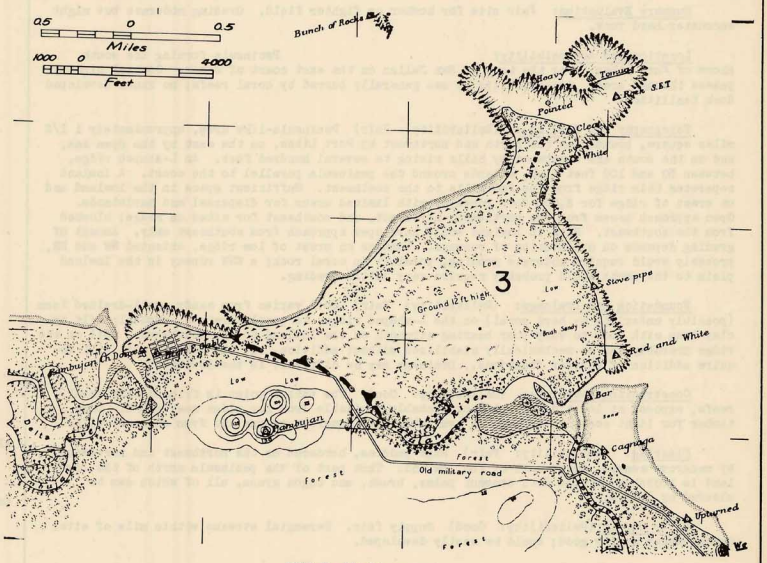
Topography and Grading: (Reliability: Good) Flat or hummocky area, approximately 2 x 3 miles, reported to be 12 feet high probably underlain by coral reef. Approaches somewhat limited from south and southwest; all other directions clear. Ample space with clear approaches for 6,000-foot runways oriented NW and ENE and for dispersal areas. Very little grading required. Concealment probably generally poor. Topographically, this is one of the best sites on Samar.

Foundation and Drainage: (Reliability: Fair) Soil is sandy loam; probably underlain by coral. Drainage probably good, although side drains may be necessary to handle occasional excess rainfall. Soil nonplastic, with good bearing strength.

Construction Materials: (Reliability: Good) Coral, exposed at low tide along the east and north coasts and locally along the west, is best and most readily accessible construction material. Sand is probably available from the beach along the west coast of the peninsula. Timber will be generally scarce on the point itself, but is plentiful in the foothills south of the highway. Some mangrove is available near Pambujan and around the inlet on the southeast side of the point.

Clearing and Drainage: (Reliability: Good) The area is believed to be covered with brush, secondary timber, and open grassland, with a few areas of cultivated ground and coconut palm. Probably little clearing that cannot be handled with a dozer.

Water Supply: (Reliability: Good) Supply poor to fair. Perennial streams within 2 miles. Ground water could be readily developed but heavy pumping of wells will bring in salt water.



AREA 3 (LIVAS POINT)

Contour Interval 25 feet

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE (P.I.)

Summary Evaluation: Probably several good or fair si
bomber fields, but runways generally must be parallel to c

Location and Accessibility:
plain on the north coast of Samar, between Mondragon and P
Coastal road from Catarman passes through the area. Coast
sandy beach; in part coral reef. No harbor facilities.

Topography and Grading: (Reliability: Good) Broad
flat, approximately 12 by 1 1/2 miles, cut by several larg
bounded on south by foothills which rise gradually to seve
feet. Broken coastal ridge, up to 60 feet high, approxima
mile wide, extends parallel to coast northwest of Bantayan
continues east of Bantayan but with elevation of less than
Hill 73 feet high between Oot Pt. and Paninirongan. Betwe
coastal ridge and the foothills are flat, interstream area
enough for 6,000-foot runways. Approaches will be general
what obstructed from the south and east. North approaches
because of coastal ridge locally around Bantayan Bay, but
will be good. Ground relatively flat, with little grading
except near streams. Ample space for dispersal areas.

Foundation and Drainage: (Reliability: Fair) In ge
soil in the interstream areas near the coast is sandy or s
well drained, with good to fair bearing strength. Back fr
coast, near the base of the foothills, silt or clay loams
nate; internal drainage poor; subdrains required before ad
coarse fraction. Areas near streams probably periodically
surface drainage in the interstream areas probably good ex
exceptionally heavy rainfall.

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AREA 2 (MONDRAGON)

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Coastal
Pambujan.
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Construction Materials: (Reliability:Fair) Coral reefs, exposed at low tide between Mondragon and Bugko Pt, and on the north side of Cot Pt, will be the best source of construction stone; both localities readily accessible by coast road. Sand available from beach, particularly along Bantayan Bay. Sand and gravel probably available in beds of the streams, two to four miles from coast. Timber available in foothills, back from coast (probably most accessible west of Mondragon); some mangrove on coast between Laoangan and Paninirongan and near Pambujan.

Clearing and Grubbing (Reliability: Fair) Most of area probably either in coconut palm or second growth timber, both of which can be cleared with dozers. Probably considerable areas, particularly along the rivers, will be in field cultivation, and open grassland is reported around Bantayan Bay and on Oot Pt.

Water Supply: (Reliability: Good) Abundant water readily available.

SUGGESTED AIRDROME SITES

EXPLANATION OF VEGETATION SYMBOLS

Mud flat

Mangrove

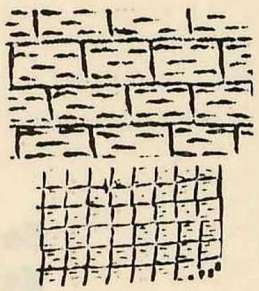
Deciduous trees

Coconut palms

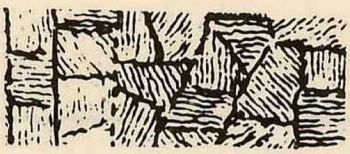
Hemp

Corn

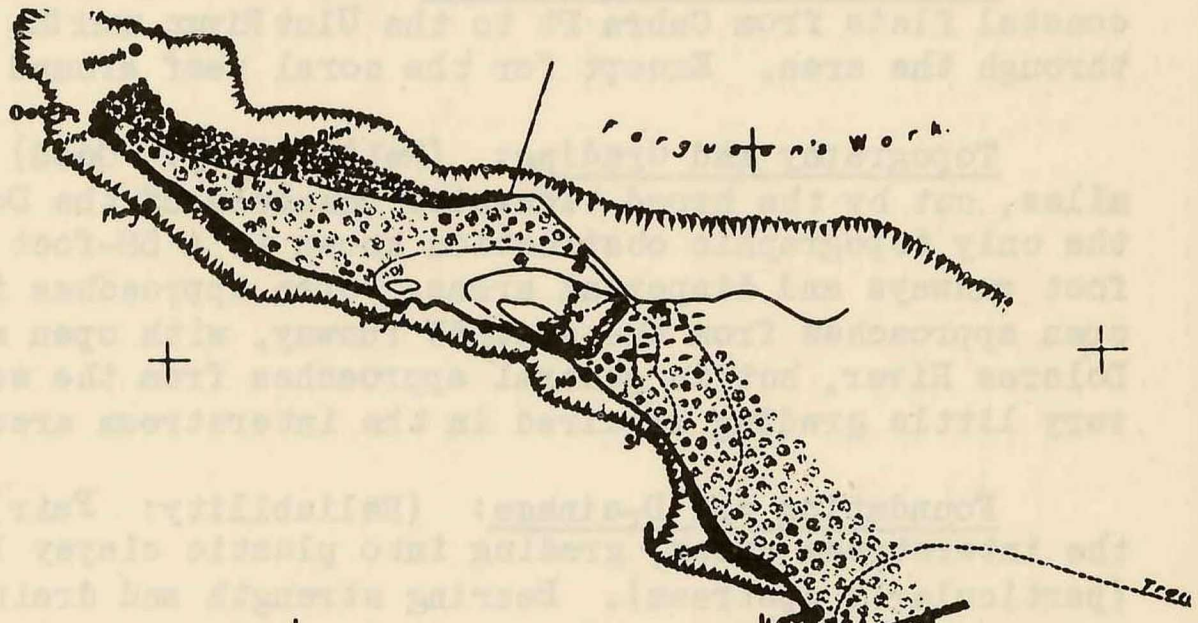
Sugar cane



Rice paddies

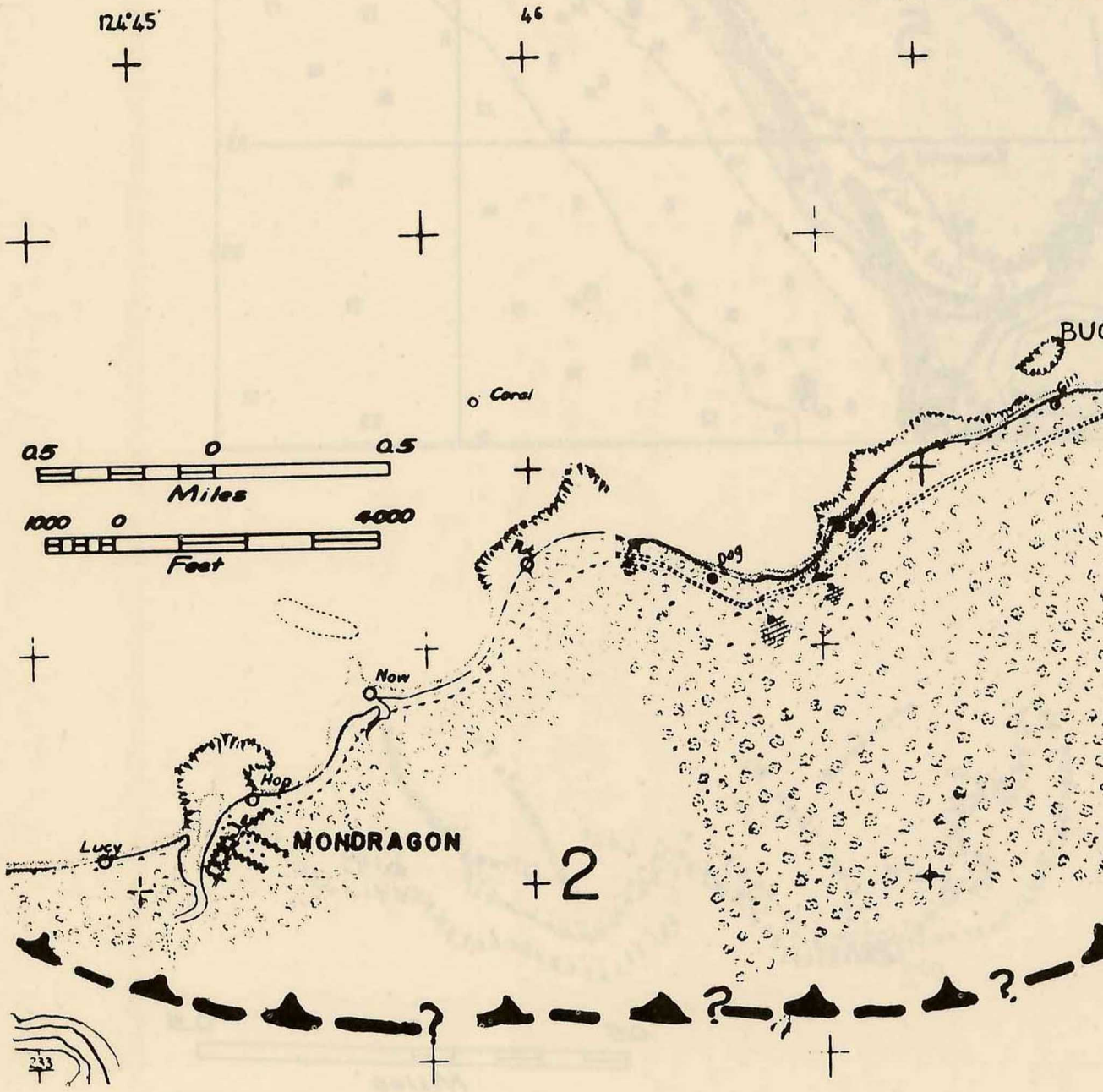


Cultivated fields



AREA 2 (MONDR

Contour Interv

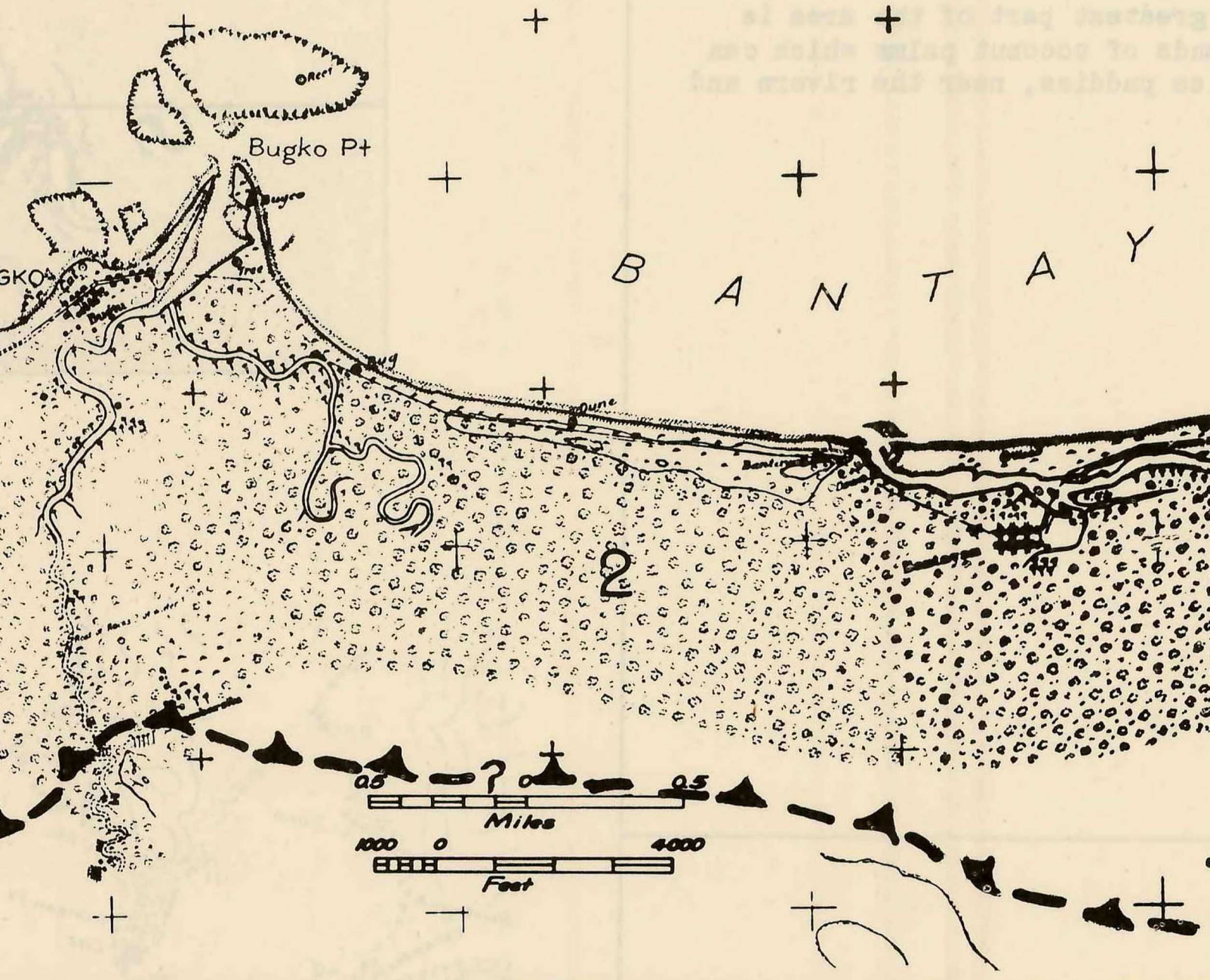


AREA 3 (LIVAS POINT)

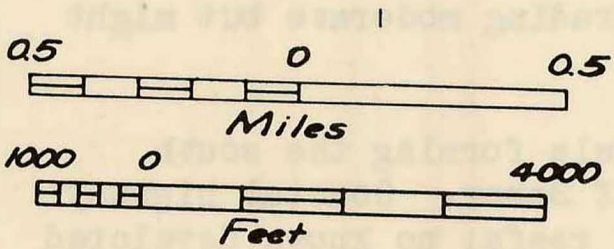
Summary Evaluation: Excellent site for quick construct
graphy, approaches, and soil good; drainage fair.

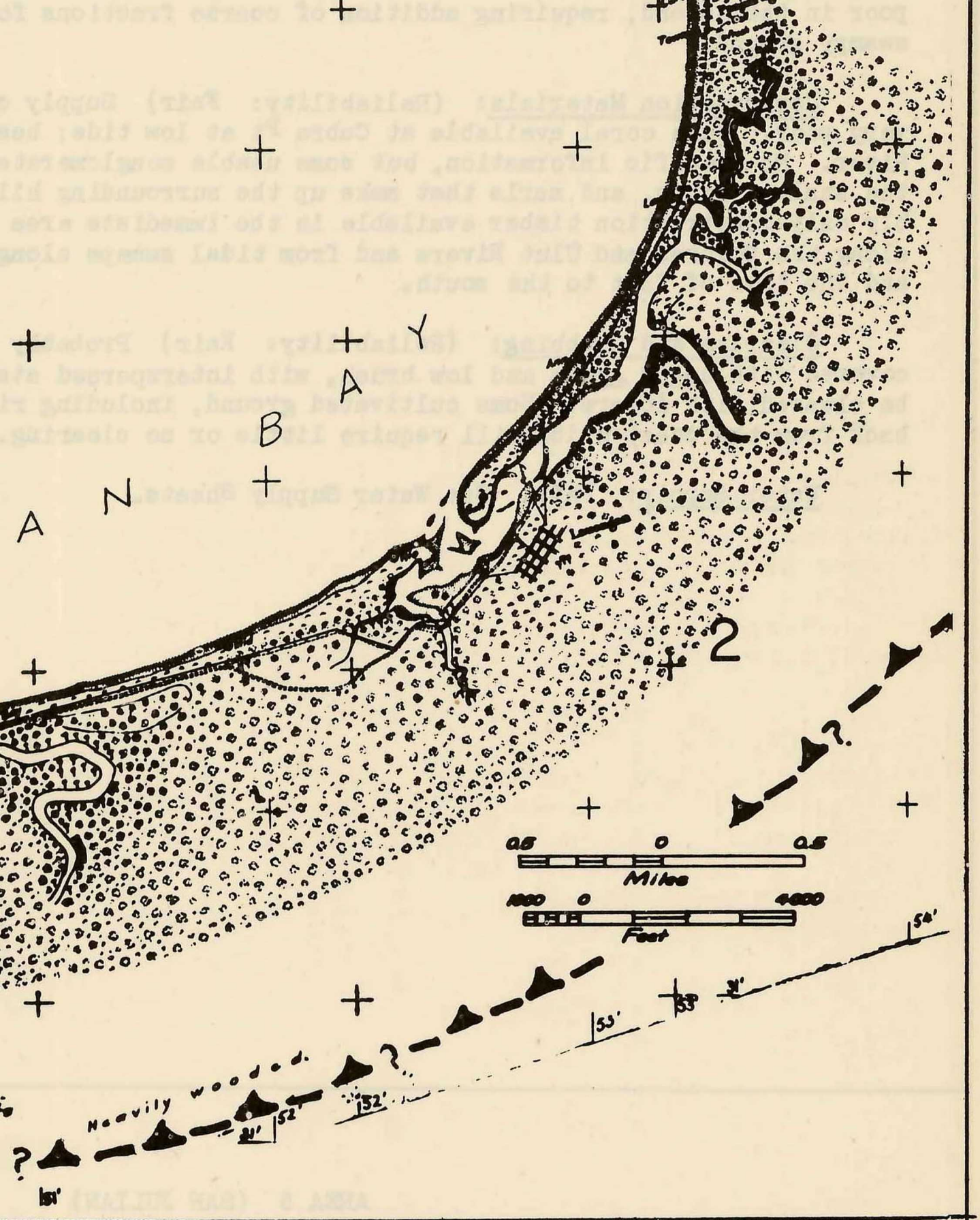
RAGON)

al 20 feet, except west of Mondragon where it is 50 feet



sion of bomber field. Topo-




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2
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Miles
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0
4000
Feet
54'
53'
52'
51'
Heavily wooded
Bunch of Rocks
Heavy Tornado
A Rock S.E.T

Location and Accessibility:
area on the north coast of Samar, extending north from the c
of Pambujan and Burabud. The road provides the best means o
between coral reefs along the west side of the area. The ea
by coral.

Topography and Grading: (Reliability: Good) Flat or
2 x 3 miles, reported to be 12 feet high probably underlain
somewhat limited from south and southwest; all other directi
clear approaches for 6,000-foot runways oriented NW and ENE
Very little grading required. Concealment probably generall
this is one of the best sites on Samar.

Foundation and Drainage: (Reliability: Fair) Soil is
lain by coral. Drainage probably good, although side drains
occasional excess rainfall. Soil nonplastic, with good bear

Construction Materials: (Reliability: Good) Coral, e
east and north coasts and locally along the west, is best an
struction material. Sand is probably available from the bea
the peninsula. Timber will be generally scarce on the point
the foothills south of the highway. Some mangrove is availa
the inlet on the southeast side of the point.

Clearing and Drainage: (Reliability: Good) The area
with brush, secondary timber, and open grassland, with a few
and coconut palm. Probably little clearing that cannot be h

Water Supply: (Reliability: Good) Supply poor to fai
2 miles. Ground water could be readily developed but heavy
in salt water.

A flat, peninsula-like
coastal road between the towns
of access; some sandy beach
ast side is entirely fringed

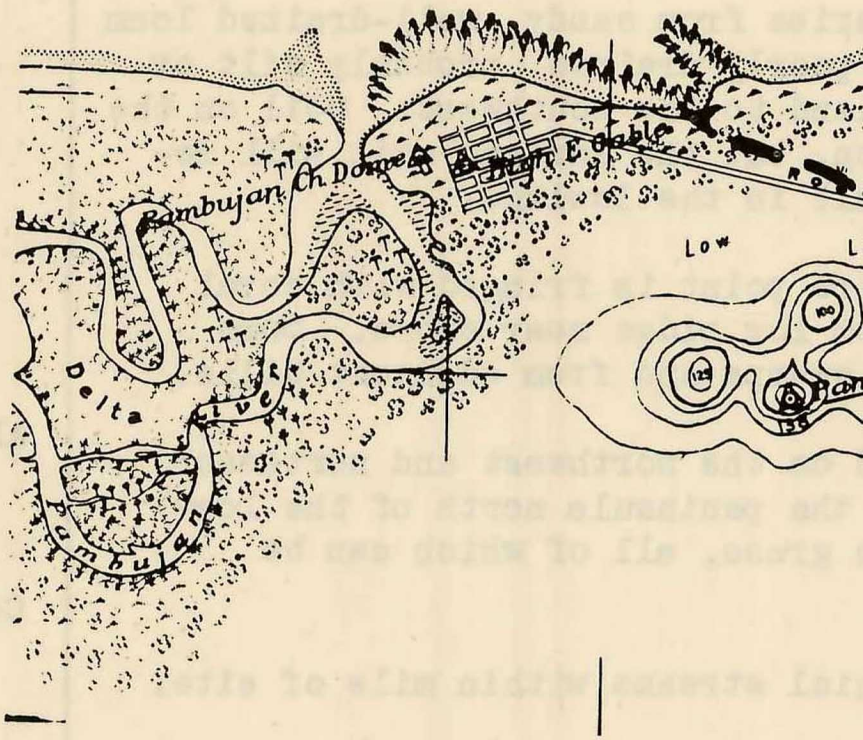
hummocky area, approximately
by coral reef. Approaches
ons clear. Ample space with
and for dispersal areas.
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sandy loam; probably under-
may be necessary to handle
ring strength.

xposed at low tide along the
d most readily accessible con-
ch along the west coast of
itself, but is plentiful in
ble near Pambujan and around

is believed to be covered
areas of cultivated ground
andled with a dozer.

r. Perennial streams within
pumping of wells will bring



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REA 3 (LIVAS POINT)

ontour Interval 25 feet

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 4 (LAONG)

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 5 (DOLORES)

Summary Evaluation: Generally favorable. Several flat areas large enough for bomber runways; clear approaches parallel to shore.

Location and Accessibility: On the east coast of Samar, coastal flats from Cabra Pt to the Ulut River, near the town of Dolores. East coastal road passes through the area. Except for the coral reef around Cabra Pt, good sandy beach.

Topography and Grading: (Reliability: Good) Broad coastal plain, about 8 by 1 1/2 miles, cut by the broad tidewater channels of the Dolores and Ulut Rivers. Within the area, the only topographic obstruction known is a 58-foot hill on Cabra Pt. Ample space for 6,000-foot runways and dispersal areas. Open approaches for NE runways except near the Ulut River; open approaches from the east, NW runway, with open approach zones, possible south of the Dolores River, but in general approaches from the west are limited by the foothills. Probably very little grading required in the interstream areas. Concealment poor.

Foundation and Drainage: (Reliability: Fair) Sandy or silty loam on Cabra Pt and on the interstream areas, grading into plastic clayey loam near the Dolores and Ulut Rivers (particularly upstream). Bearing strength and drainage fair to good in the first; probably poor in the second, requiring addition of coarse fractions for stabilization. Little or no swampy ground.

Construction Materials: (Reliability: Fair) Supply of construction materials generally very poor. Some coral available at Cabra Pt at low tide; beach sand from Cabra Pt to the Ulut River. No specific information, but some usable conglomerate may be present interbedded in the shales, sands, and marls that make up the surrounding hills on the west and south. Probably only construction timber available in the immediate area is mangrove from small stands along the Dolores and Ulut Rivers and from tidal swamps along the coast between the Ulut River and the town of Taft to the south.

Clearing and Grubbing: (Reliability: Fair) Probably greatest part of the area is covered with cogon grass and low brush, with interspersed stands of coconut palms which can be cleared with dozers. Some cultivated ground, including rice paddies, near the rivers and back from the coast which will require little or no clearing.

Water Supply: Fair. See Water Supply Sheets.

AREA 6 (SAN JULIAN)

Summary Evaluation: Fair site for bomber or fighter field. Grading moderate but might encounter hard rock.

Location and Accessibility: Peninsula forming the south shore of Port Libas, near the town of San Julian on the east coast of Samar. Coastal highway passes through area. Accessibility by sea generally barred by coral reefs; no known developed dock facilities.

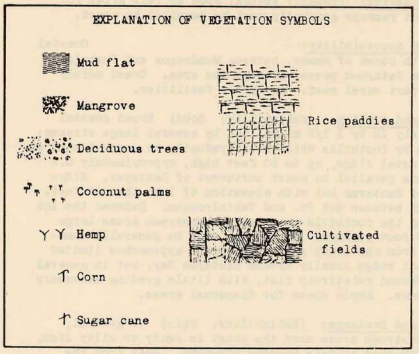
Topography and Grading: (Reliability: Fair) Peninsula-like area, approximately 1 1/2 miles square, bounded on the north and northwest by Port Libas, on the east by the open sea, and on the south and southwest by hills rising to several hundred feet. An L-shaped ridge, between 50 and 100 feet high, extends around the peninsula parallel to the coast. A lowland separates this ridge from the foothills to the southwest. Sufficient space in the lowland and on crest of ridge for 6,000-foot runways, with limited areas for dispersal and hardstands. Open approach zones from the northwest, northeast, and southeast for sites on ridge; blocked from the southwest. Site in lowland would have open approach from southeast only. Amount of grading depends on orientation of runways. Runways on crest of low ridge, oriented NW and NE, probably would require moderate grading, possibly in coral rock; a WNW runway in the lowland plain to the south would probably require very little grading.

Foundation and Drainage: (Reliability: Fair) Soil varies from sandy, well-drained loam (possibly underlain by hard coral) on the L-shaped ridge, to poorly drained, probably silt or clay loam with poor to very poor bearing strength on the lowland to the southwest. Soil on the ridge probably can be mechanically stabilized without addition, but the lowland soil will require addition of coarser fractions. Drainage may be difficult in the lowland.

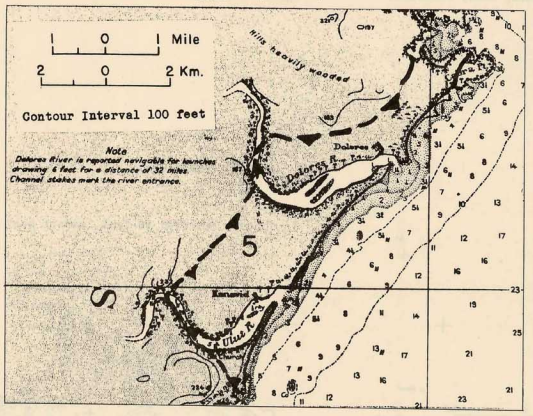
Construction Materials: (Reliability: Good) The entire point is fringed with coral reefs, exposed at low tide; coral rock probably available from low ridge near shore. Some timber for light construction may be available from mangrove swamps and from adjacent hills.

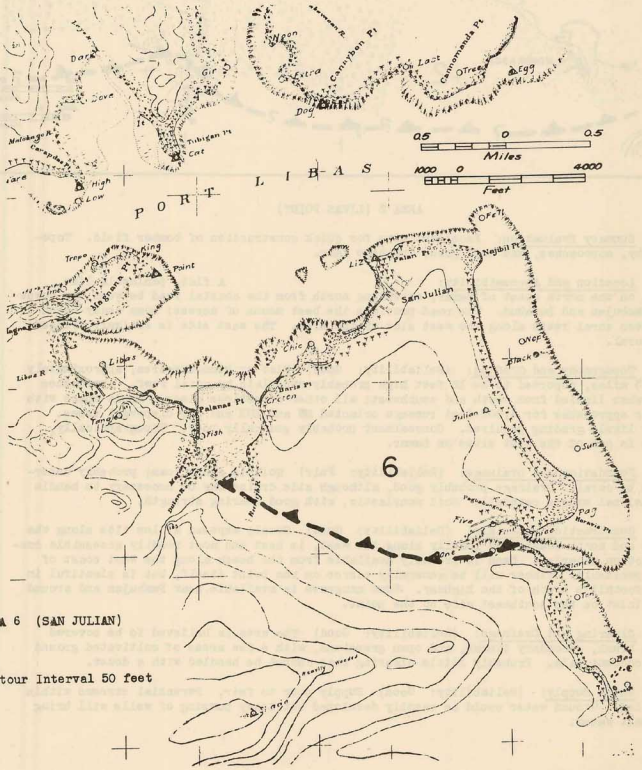
Clearing: (Reliability: Fair) Rice paddies, bordered on the northwest and northeast by mangrove swamps, cover most of the lowland. That part of the peninsula north of the lowland is probably covered with coconut palms, brush, and cogon grass, all of which can be cleared by dozers.

Water Supply: (Reliability: Good) Supply fair. Perennial streams within mile of site. Ground water supply good; could be easily developed.



AREA 5 (DOLORES)





AREA 6 (SAN JULIAN)

Contour Interval 50 feet

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

SUGGESTED AIRDROME SITES

AREA 4 (LAONG)

Little information availab
See Suggested Airdrome Sites Ind
Map and Summary Tabulation of Ai
drome Site Data.

AREA 5 (DOLORES)

Summary Evaluation: Generally favorable. Several fla
runways; clear approaches parallel to shore.

Location and Accessibility:
coastal flats from Cabra Pt to the Ulut River, near the town of
through the area. Except for the coral reef around Cabra Pt

Topography and Grading: (Reliability: Good) Broad co
miles, cut by the broad tidewater channels of the Dolores an
the only topographic obstruction known is a 58-foot hill on
foot runways and dispersal areas. Open approaches for NE ru
open approaches from the east; NW runway, with open approach
Dolores River, but in general approaches from the west are l
very little grading required in the interstream areas. Conc

Foundation and Drainage: (Reliability: Fair) Sandy o
the interstream areas, grading into plastic clayey loam near
(particularly upstream). Bearing strength and drainage fair

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ex
r-

t areas large enough for bomber

On the east coast of Samar,
Dolores. East coastal road passes
, good sandy beach.

astal plain, about 8 by 1 1/2
d Ulut Rivers. Within the area,
Cabra Pt. Ample space for 6,000-
nways except near the Ulut River;
zones, possible south of the
imited by the foothills. Probably
ealment poor.

r silty loam on Cabra Pt and on
the Dolores and Ulut Rivers
to good in the first; probably

EX

Mud

Mang

Deci

Coco

Hemp

Corn

Suga

0

2 0 2

SAMAR AND LEYTE (P.I.)

PLANATION OF VEGETATION SYMBOLS

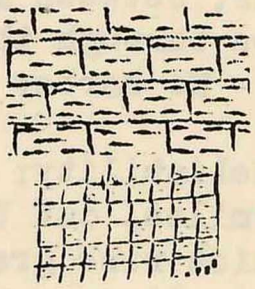
flat

rove

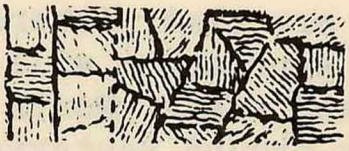
duous trees

nut palms

r cane



Rice paddies

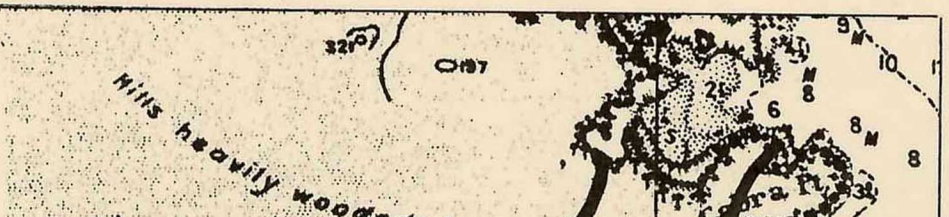


Cultivated fields

AREA 5 (DOLORES)

Mile

2 Km.



poor in the second, requiring addition of coarse fractions fo
swampy ground.

Construction Materials: (Reliability: Fair) Supply o
very poor. Some coral available at Cabra Pt at low tide; bea
River. No specific information, but some usable conglomerate
the shales, sands, and marls that make up the surrounding hil
bly only construction timber available in the immediate area
along the Dolores and Ulut Rivers and from tidal swamps along
and the town of Taft to the south.

Clearing and Grubbing: (Reliability: Fair) Probably
covered with cogon grass and low brush, with interspersed sta
be cleared with dozers. Some cultivated ground, including ri
back from the coast which will require little or no clearing.

Water Supply: Fair. See Water Supply Sheets.

AREA 6 (SAN JULIAN)

Summary Evaluation: Fair site for bomber or fighter fi
encounter hard rock.

Location and Accessibility:
shore of Port Libas, near the town of San Julian on the east
passes through area. Accessibility by sea generally barred b
dock facilities.

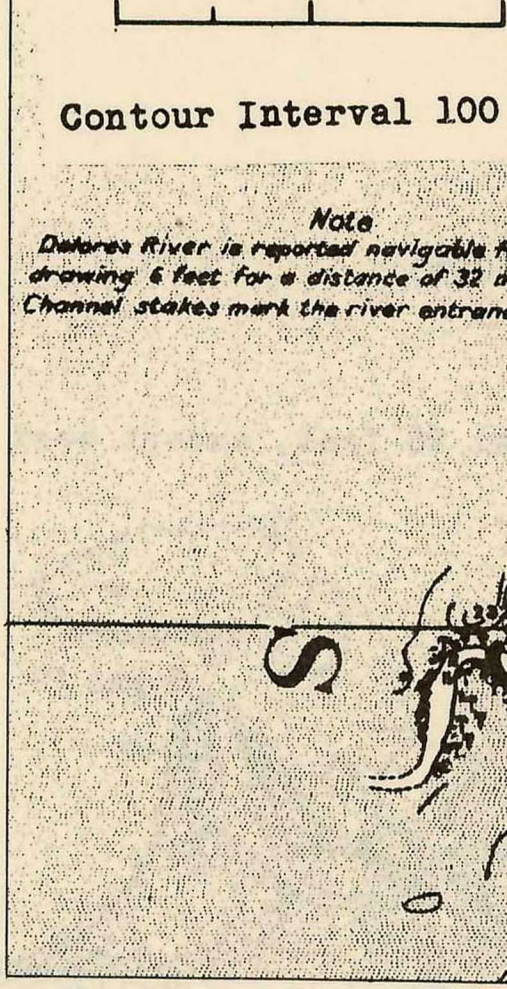
or stabilization. Little or no

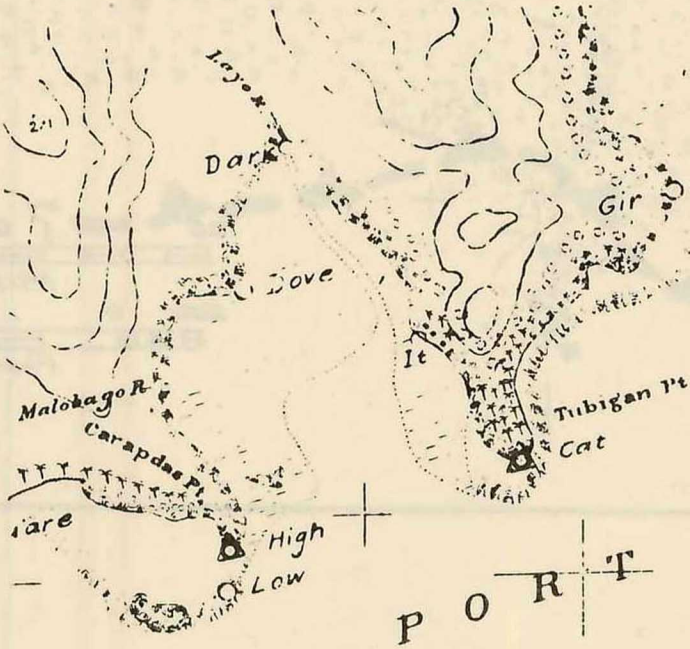
of construction materials generally
ach sand from Cabra Pt to the Ulut
e may be present interbedded in
ills on the west and south. Proba-
is mangrove from small stands
g the coast between the Ulut River

greatest part of the area is
ands of coconut palms which can
ice paddies, near the rivers and
.

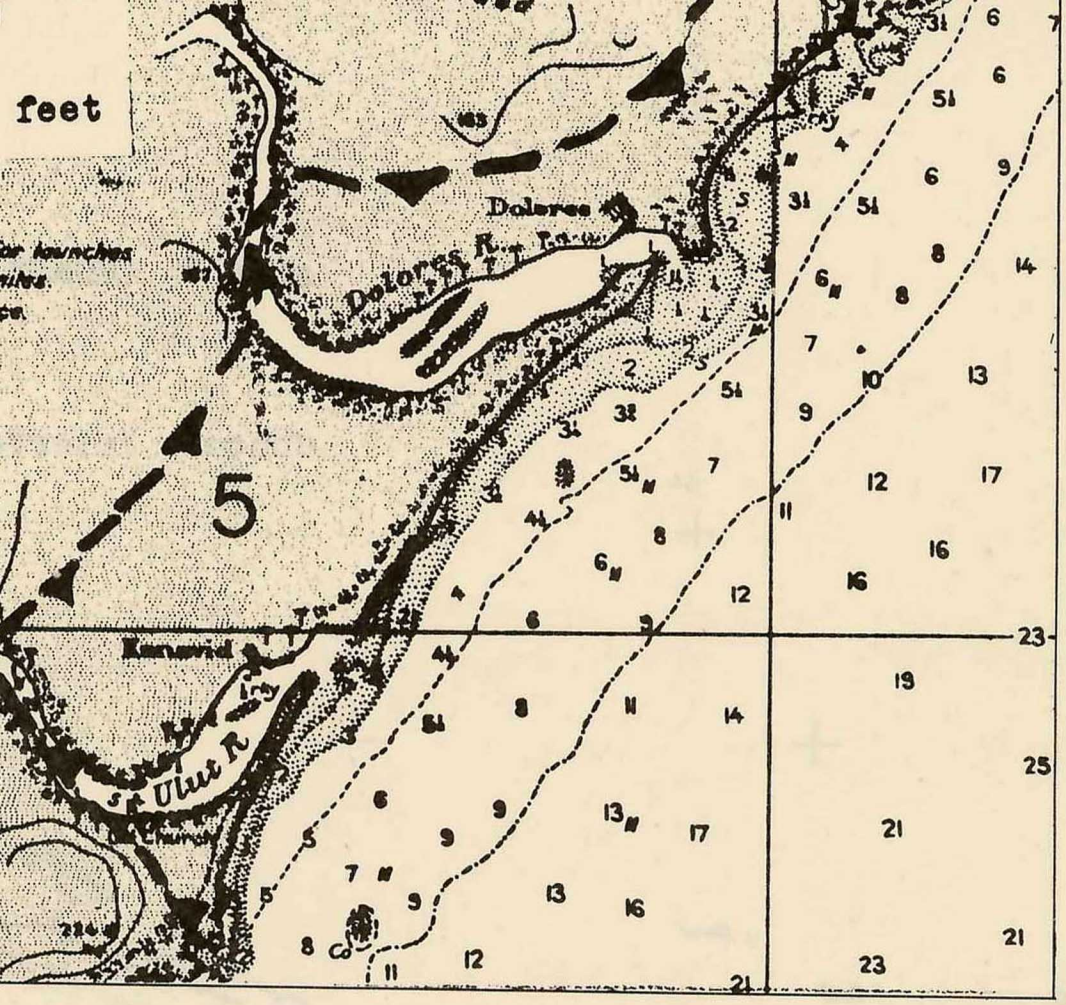
eld. Grading moderate but might

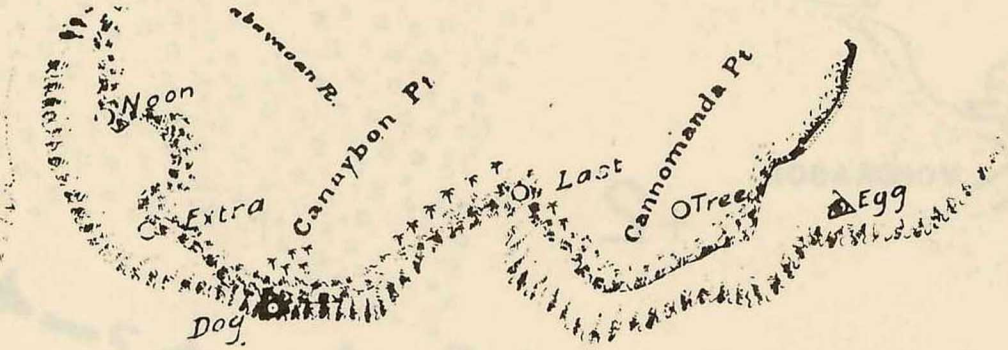
Peninsula forming the south
coast of Samar. Coastal highway
y coral reefs; no known developed







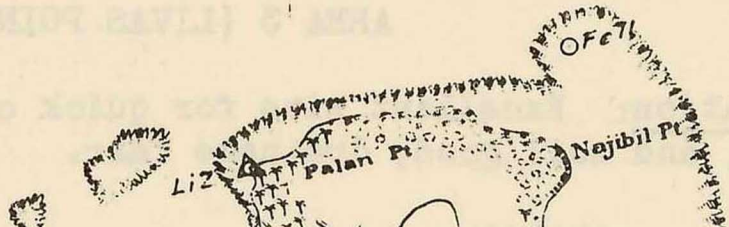




0.5 0 0.5
Miles

1000 0 4000
Feet

L I B R A S



dock facilities.

Topography and Grading : (Reliability: Fair) Peninsu
miles square, bounded on the north and northwest by Port Liba
and on the south and southwest by hills rising to several hun
between 50 and 100 feet high, extends around the peninsula pa
separates this ridge from the foothills to the southwest. Su
on crest of ridge for 6,000-foot runways, with limited areas
Open approach zones from the northwest, northeast, and southe
from the southwest. Site in lowland would have open approach
grading depends on orientation of runways. Runways on crest
probably would require moderate grading, possibly in coral ro
plain to the south would probably require very little grading

Foundation and Drainage: (Reliability: Fair) Soil va
(possibly underlain by hard coral) on the L-shaped ridge, to
clay loam with poor to very poor bearing strength on the lowl
ridge probably can be mechanically stabilized without additio
quire addition of coarser fractions. Drainage may be difficu

Construction Materials: (Reliability: Good) The enti
reefs, exposed at low tide; coral rock probably available fro
timber for light construction may be available from mangrove

Clearing: (Reliability: Fair) Rice paddies, bordered
by mangrove swamps, cover most of the lowland. That part of
land is probably covered with coconut palms, brush, and cogon
cleared by dozers.

Water Supply: (Reliability: Good) Supply fair. Perenn
Ground water supply good; could be easily developed.

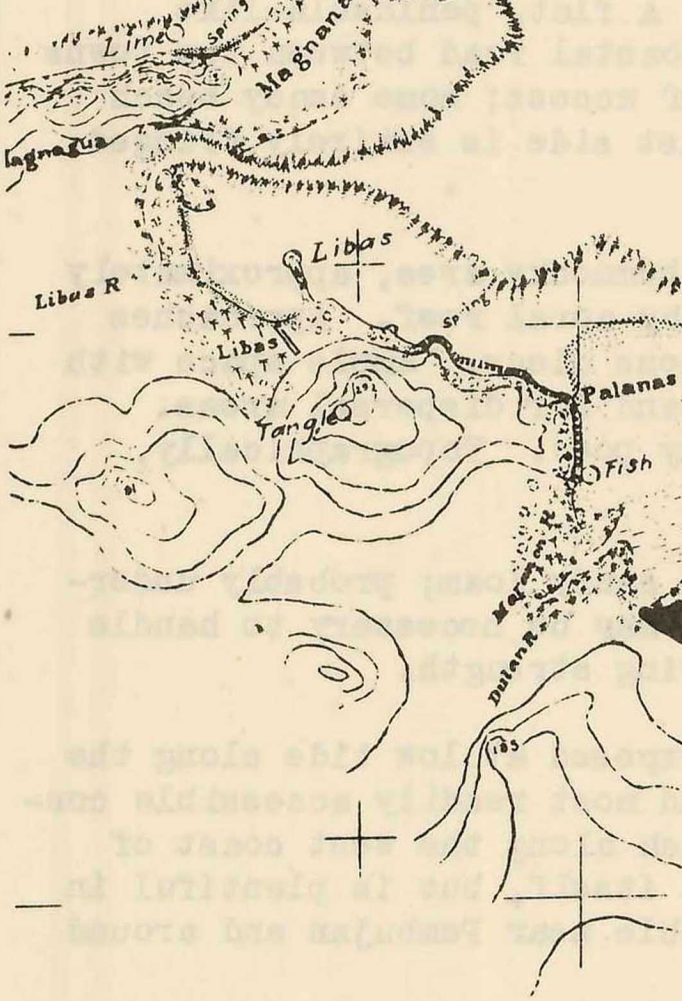
lla-like area, approximately 1 1/2
s, on the east by the open sea,
dred feet. An L-shaped ridge,
rallel to the coast. A lowland
fficient space in the lowland and
for dispersal and hardstands.
ast for sites on ridge; blocked
from southeast only. Amount of
of low ridge, oriented NW and NE,
ck; a WNW runway in the lowland
.

ries from sandy, well-drained loam
poorly drained, probably silt or
and to the southwest. Soil on the
n, but the lowland soil will re-
lt in the lowland.

re point is fringed with coral
m low ridge near shore. Some
swamps and from adjacent hills.

on the northwest and northeast
the peninsula north of the low-
grass, all of which can be

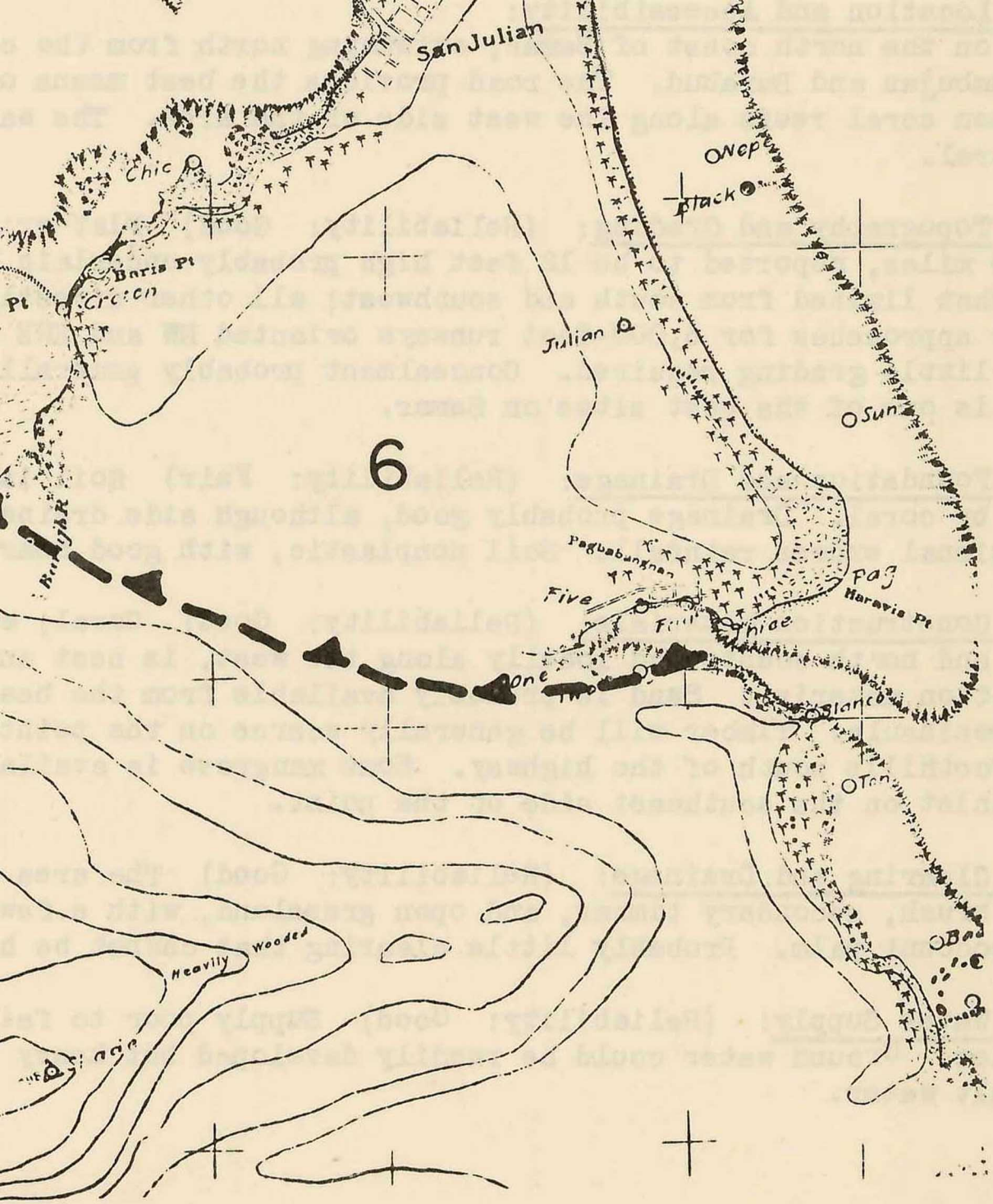
ial streams within mile of site.



AREA 6 (SAN JULIAN)

Contour Interval 50 feet

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Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

AREA 7 (BORANGON)

Summary Evaluation: The small field known to be in existence in 1941 could be expanded to fighter size with moderate grading. Elsewhere, at least two sites large enough for bomber runways with clear approaches.

Location and Accessibility: Coastal strip on the east coast of Samar, extending from the Borongan River south to the Bihid River, including Borongan, the largest town in east Samar. Coastal highway passes through area, and limited dock facilities available at Borongan. Sandy beach fronts much of area. Small landing strip one mile east of Borongan with one runway oriented NE 2,360 by 100 feet.

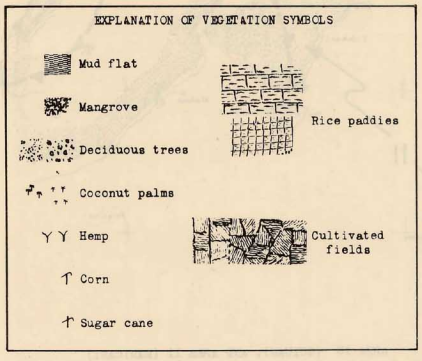
Topography and Drainage: (Reliability: Fair) The present field could probably be considerably enlarged, although a low hill east of the strip would have to be removed to give adequate width. Approaches clear from northeast only. The large flat extending northward from the town approximately 1 1/2 miles to the Borangan River is large enough for 6,000-foot runways but approaches would be limited except from east and southeast. See accompanying view and also View 12.in section on Terrain Appreciation. There is space for a 5000-foot runway on the northern tip of Lalawigan Pt, with clear east and west approaches. Ample space from Lalawigan Pt south to the Bihid River for sites with N-S runways only. Except for the hill east of present field, the area is probably more or less flat, and grading would be light. Generally ample space for disperal areas.

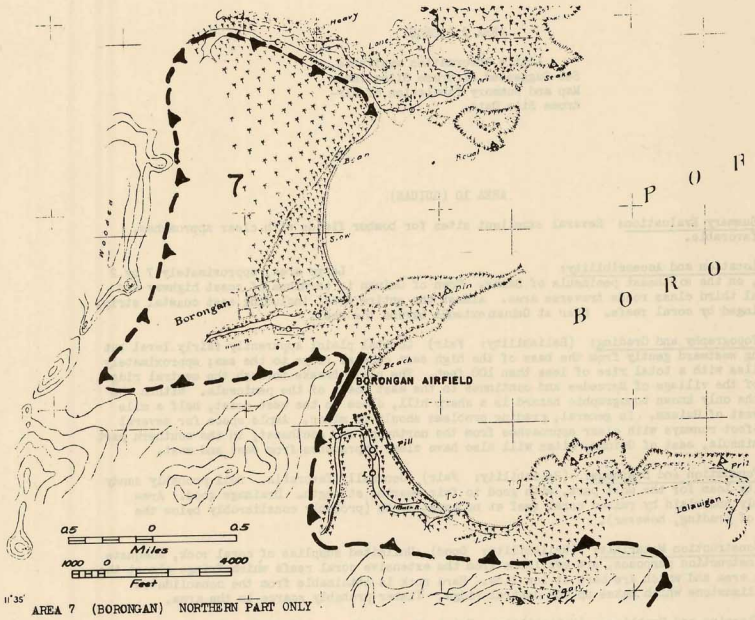
Foundation and Drainage: (Reliability: Fair) Soil generally sandy to silty loam, well drained, and with good to fair bearing strength. Over greater part of the area can probably be stabilized without addition.

Construction Materials: (Reliability: Fair) Supply of construction materials rather poor. The coral reef on the point just northeast of the present field, and that fringing the north side of Lalawigan Pt are probably the best sources of adequate rock. Timber for construction available in the hills at west.

Clearing and Grubbing: (Reliability: Good) Area covered with coconut palm, which can be cleared with dozers.

Water Supply: (Reliability: Good) Ample water supply from perennial streams.





AREA 7 (BORONGAN) NORTHERN PART ONLY

Contour Interval 50 feet



Airfield at Borongon, Samar (northern part AREA 7). View to the north. 1939. (A. C. 20463)

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

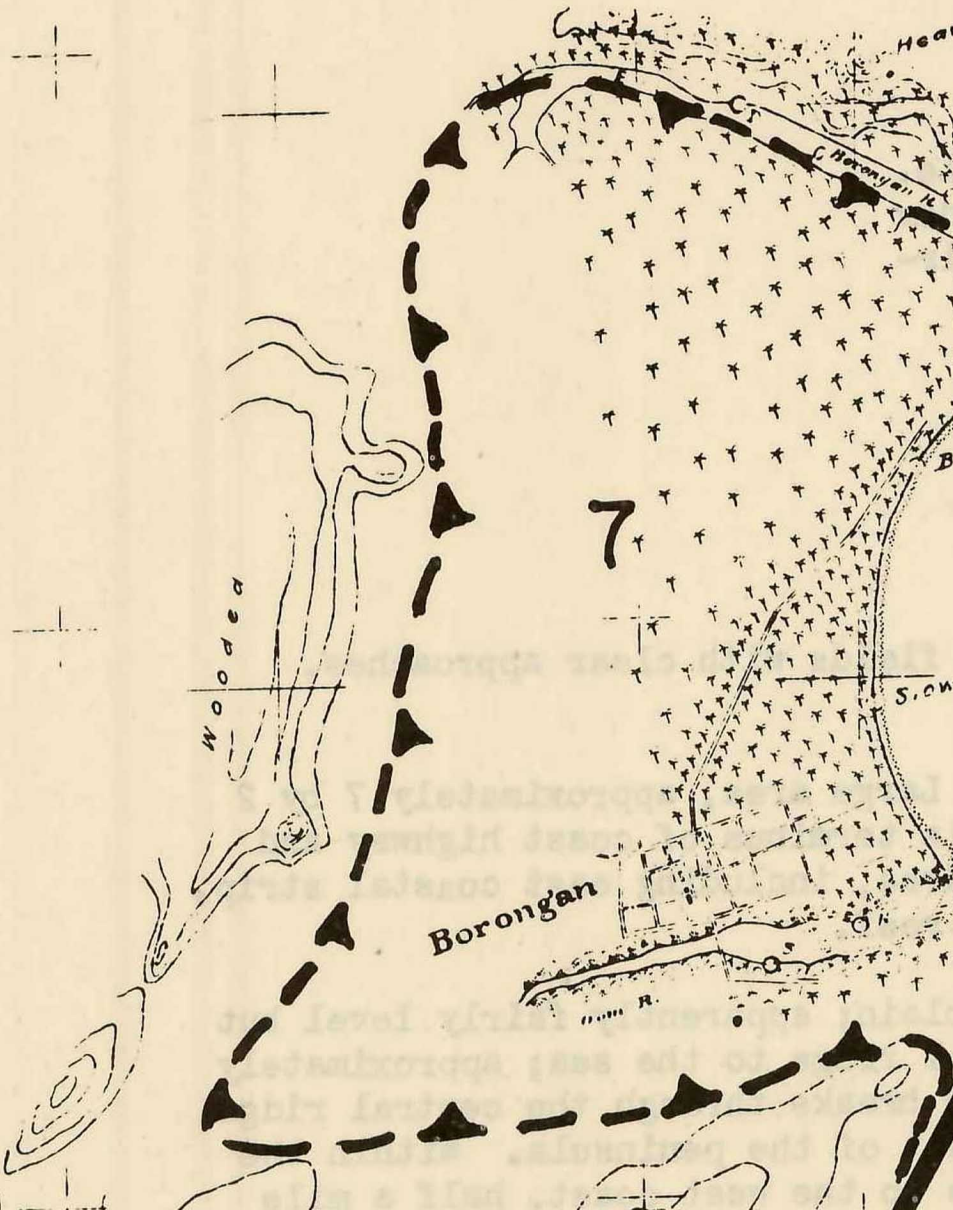
SAMAR AND LEYTE(P.I.)

AREA 7 (BORANGON)

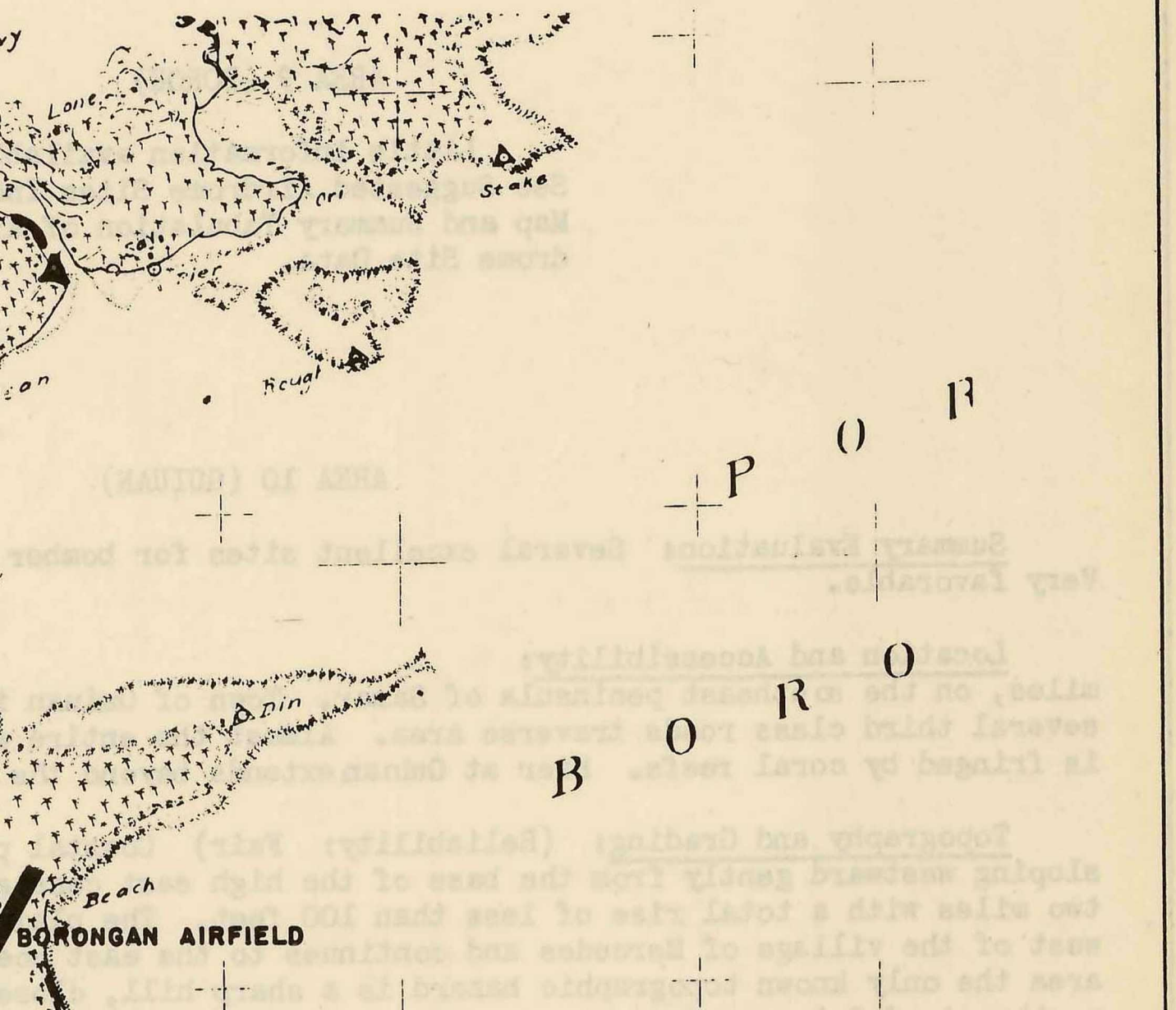
Summary Evaluation: The small field known to be in
ence in 1941 could be expanded to fighter size with mod
grading. Elsewhere, at least two sites large enough fo
bomber runways with clear approaches.

Location and Accessibility:
Coastal strip on the east coast of Samar, extending fro
Borongan River south to the Bihid River, including Boro
the largest town in east Samar. Coastal highway passes
through area, and limited dock facilities available at
Borongan. Sandy beach fronts much of area. Small land
strip one mile east of Borongan with one runway orients

[redacted]



SUGGESTED AIRDROME SITES



NE 2,360 by 100 feet.

Topography and Drainage: (Reliability: Fair) Th present field could probably be considerably enlarged, although a low hill east of the strip would have to be moved to give adequate width. Approaches clear from nc only. The large flat extending northward from the town imately 1 1/2 miles to the Borangan River is large enou 6,000-foot runways but approaches would be limited exce from east and southeast. See accompanying view and als 12.in section on Terrain Appreciation. There is space 5,000-foot runway on the northern tip of Lalawigan Pt, wi clear east and west approaches. Ample space from Lalaw Pt south to the Bihid River for sites with N-S runways Except for the hill east of present field, the area is ably more or less flat, and grading would be light. Ge ample space for disperal areas.

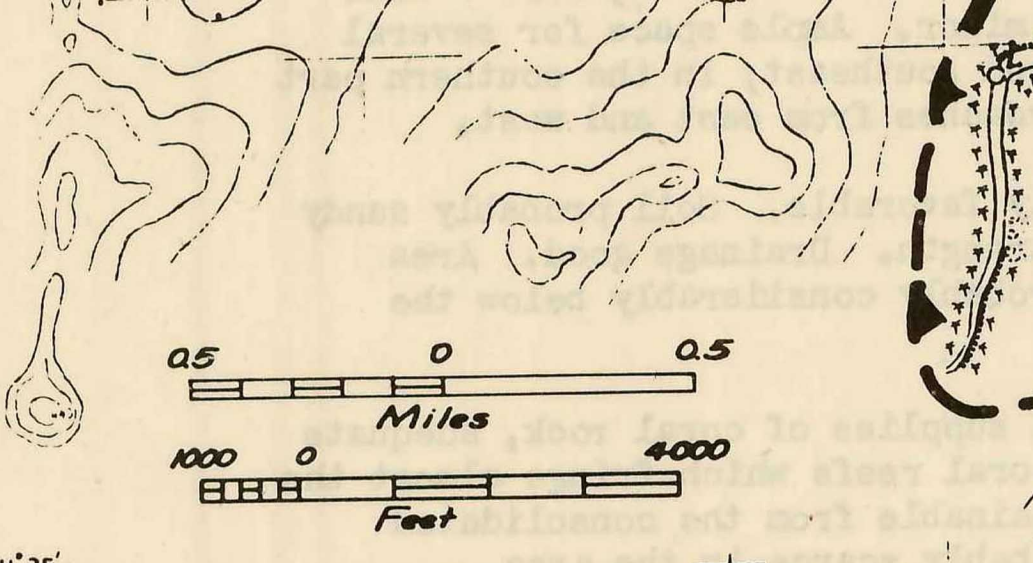
Foundation and Drainage: (Reliability: Fair) Soi generally sandy to silty loam, well drained, and with g fair bearing strength. Over greater part of the area c ably be stabilized without addition.

Construction Materials: (Reliability: Fair) Sup construction materials rather poor. The coral reef on point just northeast of the present field, and that fri the north side of Lalawigan Pt are probably the best so of adequate rock. Timber for construction available in hills at west.

Clearing and Grubbing: (Reliability: Good) Area covered with coconut palm, which can be cleared with do

Water Supply: (Reliability: Good) Ample water s from perennial streams.

EXPLANATION OF VEGETATION SYMBOLS

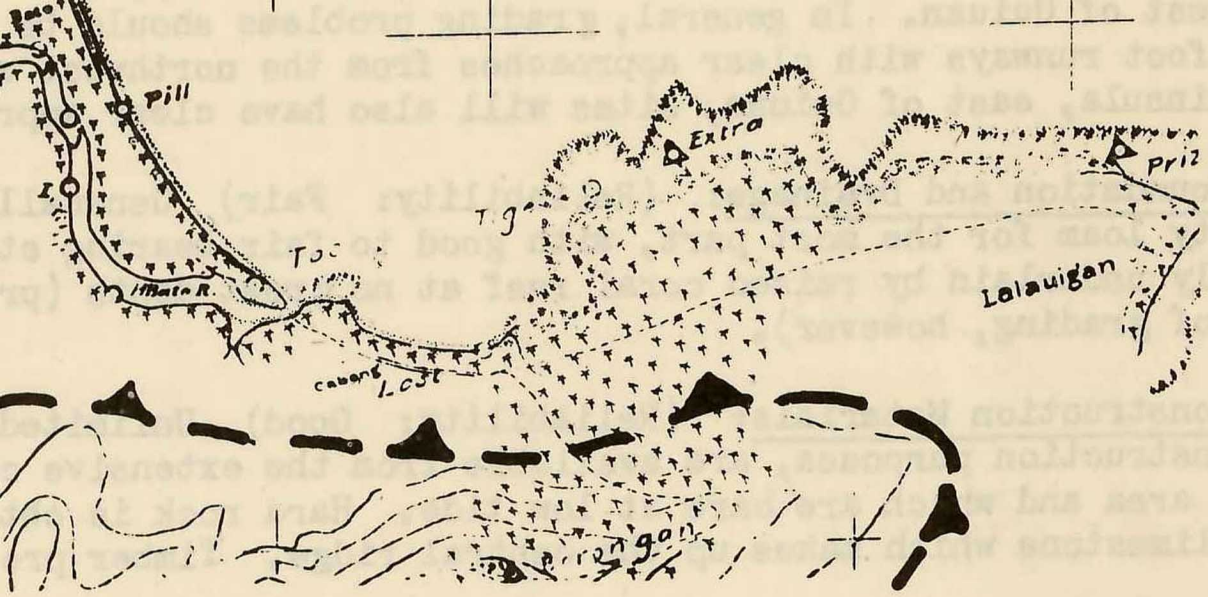


11°35'

AREA 7 (BORONGAN) NORTHERN PART ONLY

Contour Interval 50 feet




Pill
Extra
Priz
Lalauigan
Ilhata R.

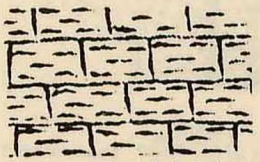


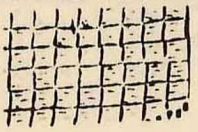


Mud flat



Mangrove





Rice paddi



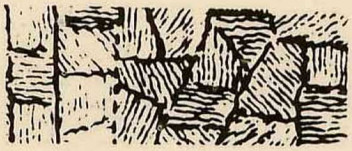
Deciduous trees



Coconut palms



Hemp



Cultivated fields



Corn



Sugar cane



Airfield at Borongon, Samar (northern part A



REA 7). View to the north. 1939. (A. C. 20463)

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 8 (HERNANI)

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 9 (BOROK)

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 10 (GUIUAN)

Summary Evaluation: Several excellent sites for bomber fields with clear approaches. Very favorable.

Location and Accessibility: Large area, approximately 7 by 2 miles, on the southeast peninsula of Samar. Town of Guiuan is terminus of coast highway and several third class roads traverse area. Almost the entire area, including east coastal strip, is fringed by coral reefs. Pier at Guinan extends beyond the reef.

Topography and Grading: (Reliability: Fair) Coastal plain; apparently fairly level but sloping westward gently from the base of the high east coastal ridge to the sea; approximately two miles with a total rise of less than 100 feet. The plain breaks through the central ridge west of the village of Mercedes and continues to the east coast of the peninsula. Within the area the only known topographic hazard is a sharp hill, close to the west coast, half a mile northwest of Guiuan. In general, grading problems should be minor. Ample space for several 6,000-foot runways with clear approaches from the northwest and southeast; in the southern part of peninsula, east of Guiuan, sites will also have clear approaches from east and west.

Foundation and Drainage: (Reliability: Fair) Generally favorable. Soil probably sandy or silty loam for the most part, with good to fair bearing strength. Drainage good. Area probably underlain by raised coral reef at no great depth (probably considerably below the depth of grading, however).

Construction Materials: (Reliability: Good) Unlimited supplies of coral rock, adequate for construction purposes, are available from the extensive coral reefs which fringe almost the entire area and which are bare at low tide. Hard rock is obtainable from the consolidated coral limestone which makes up the central ridge. Timber probably scarce in the area.

Clearing and Grubbing: (Reliability: Fair) Most of the area is believed to be under cultivation, though some of it has doubtless returned to brush and grassland. Coconut-palm groves will probably be the most difficult clearing encountered.

Water Supply: (Reliability: Fair) Surface water supply poor. Ground water supply excellent; large quantities could be quickly developed.

AREA 11 (MANICANI)

The areas shown on two small islands Manicani and Tubabao, are topographically fairly favorable for fighter sites. Areas are not discussed in detail because of their inaccessibility. Data summarized as follows:

Accessibility: Poor
Topography: Fair
Drainage: Good
Soil: Good
Water Supply: Fair
Accessibility of Construction Materials: Fair
Ease of Clearing: Fair

AREA 12 (CABARASAN)

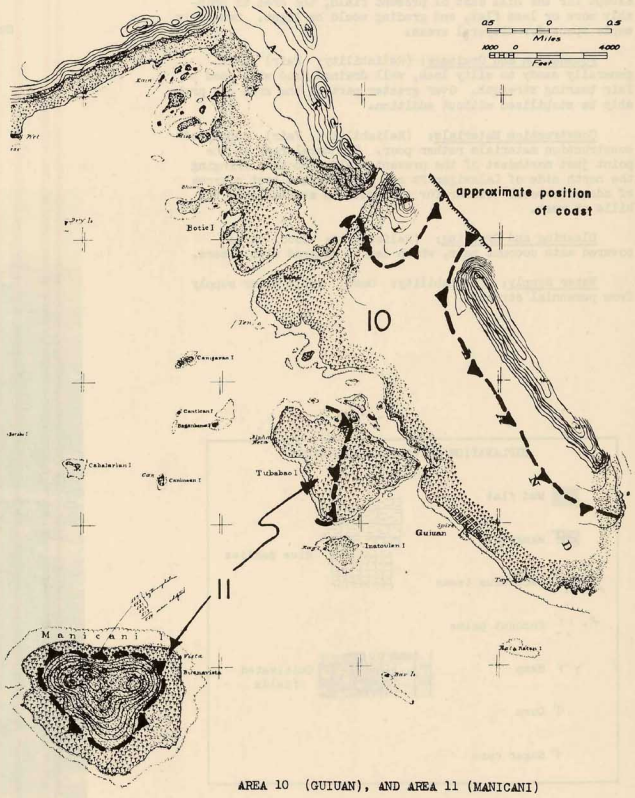
Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 13 (CABLANGA)

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

EXPLANATION OF VEGETATION SYMBOLS

Mud flat
Mangrove
Deciduous trees
Coconut palms
Hemp
Corn
Sugar cane
Rice paddies
Cultivated fields



AREA 10 (GUIUAN), AND AREA 11 (MANICANI)

Contour Interval 50 feet

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

SUGGESTED AIRDROME SITES

AREA 8 (HERNANI)

Little information availab
See Suggested Airdrome Sites In
Map and Summary Tabulation of A
drome Site Data.

AREA 9 (BOROK)

Little information availab
See Suggested Airdrome Sites In
Map and Summary Tabulation of A
drome Site Data.

AREA 10 (GUIUAN)

Summary Evaluation: Several excellent sites for bombe
Very favorable.

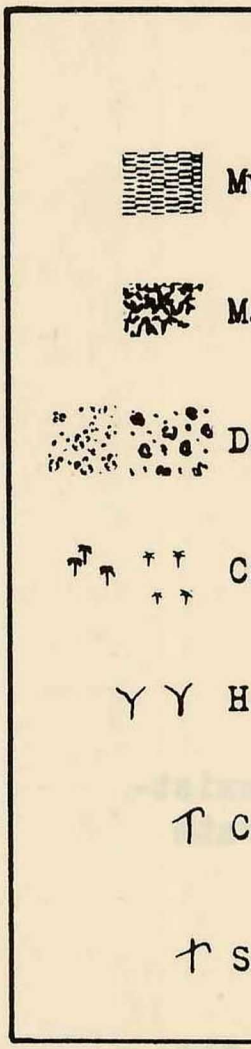
Location and Accessibility:
miles, on the southeast peninsula of Samar. Town of Guiuan
several third class roads traverse area. Almost the entire
is fringed by coral reefs. Pier at Guinan extends beyond the

Topography and Grading: (Reliability: Fair) Coastal
sloping westward gently from the base of the high east coast
two miles with a total rise of less than 100 feet. The plai
west of the village of Mercedes and continues to the east co

CONFIDENTIAL

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r fields with clear approaches.

Large area, approximately 7 by 2
is terminus of coast highway and
area, including east coastal strip,
e reef.

plain; apparently fairly level but
tal ridge to the sea; approximately
in breaks through the central ridge
east of the peninsula. Within the

SAMAR AND LEYTE(P.I.)

EXPLANATION OF VEGETATION SYMBOLS

ud flat

angrove

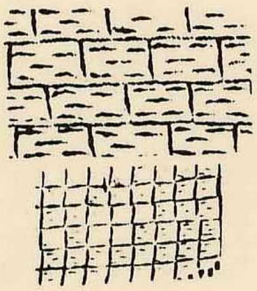
eciduous trees

oconut palms

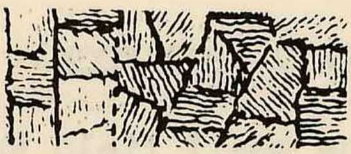
emp

orn

ugar cane



Rice paddies



Cultivated fields

area the only known topographic hazard is a sharp hill, clos
northwest of Guiuan. In general, grading problems should be
6,000-foot runways with clear approaches from the northwest
of peninsula, east of Guiuan, sites will also have clear app

Foundation and Drainage: (Reliability: Fair) General
or silty loam for the most part, with good to fair bearing s
probably underlain by raised coral reef at no great depth (p
depth of grading, however).

Construction Materials: (Reliability: Good) Unlimite
for construction purposes, are available from the extensive
entire area and which are bare at low tide. Hard rock is ob
coral limestone which makes up the central ridge. Timber pr

Clearing and Grubbing: (Reliability: Fair) Most of t
cultivation, though some of it has doubtless returned to bru
groves will probably be the most difficult clearing encounte

Water Supply: (Reliability: Fair) Surface water sup
cellent; large quantities could be quickly developed.

AREA 11 (MANICANI)

The areas shown on two small isl
Manicani and Tubabao, are topographic
fairly favorable for fighter sites.
are not discussed in detail because o
their inaccessibility. Data summariz
as follows:

Accessibility: Poor
Topography: Fair
Drainage: Good
Soil: Good
Water Supply: Fair
Accessibility of Construction Ma
Fair
Ease of Clearing: Fair

se to the west coast, half a mile
e minor. Ample space for several
and southeast; in the southern part
proaches from east and west.

lly favorable. Soil probably sandy
strength. Drainage good. Area
probably considerably below the

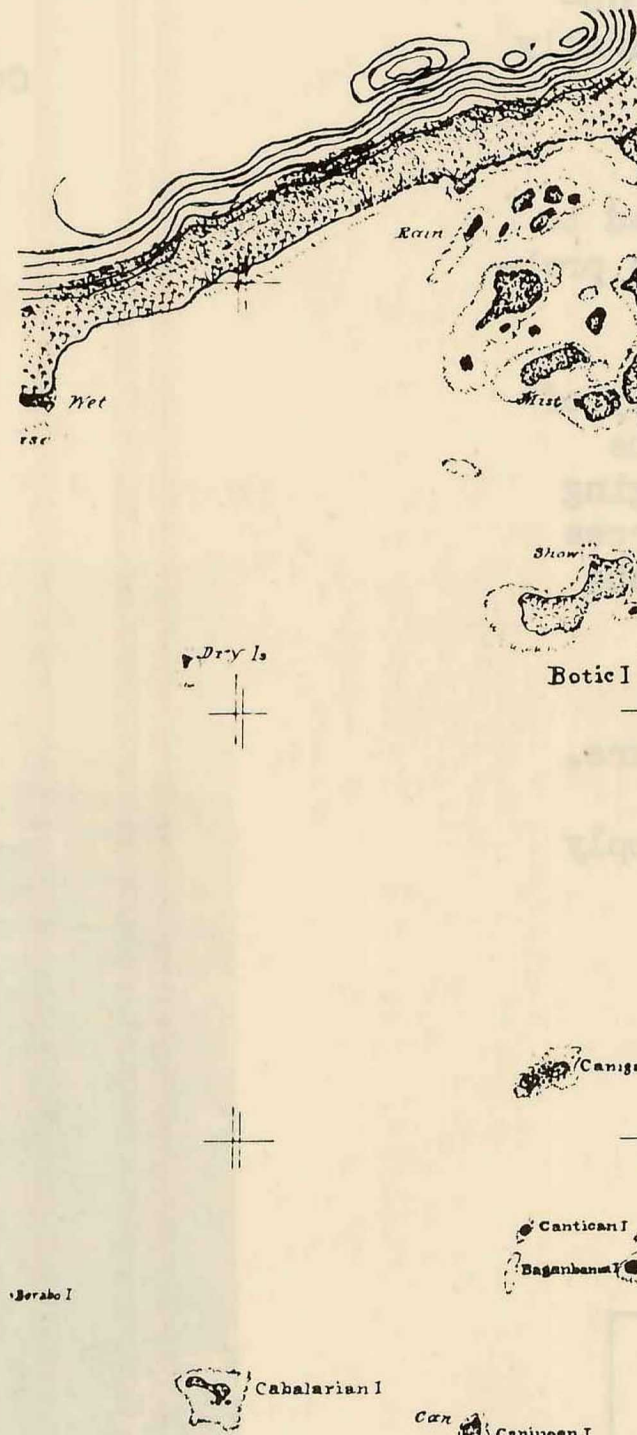
ed supplies of coral rock, adequate
coral reefs which fringe almost the
btainable from the consolidated
robably scarce in the area.

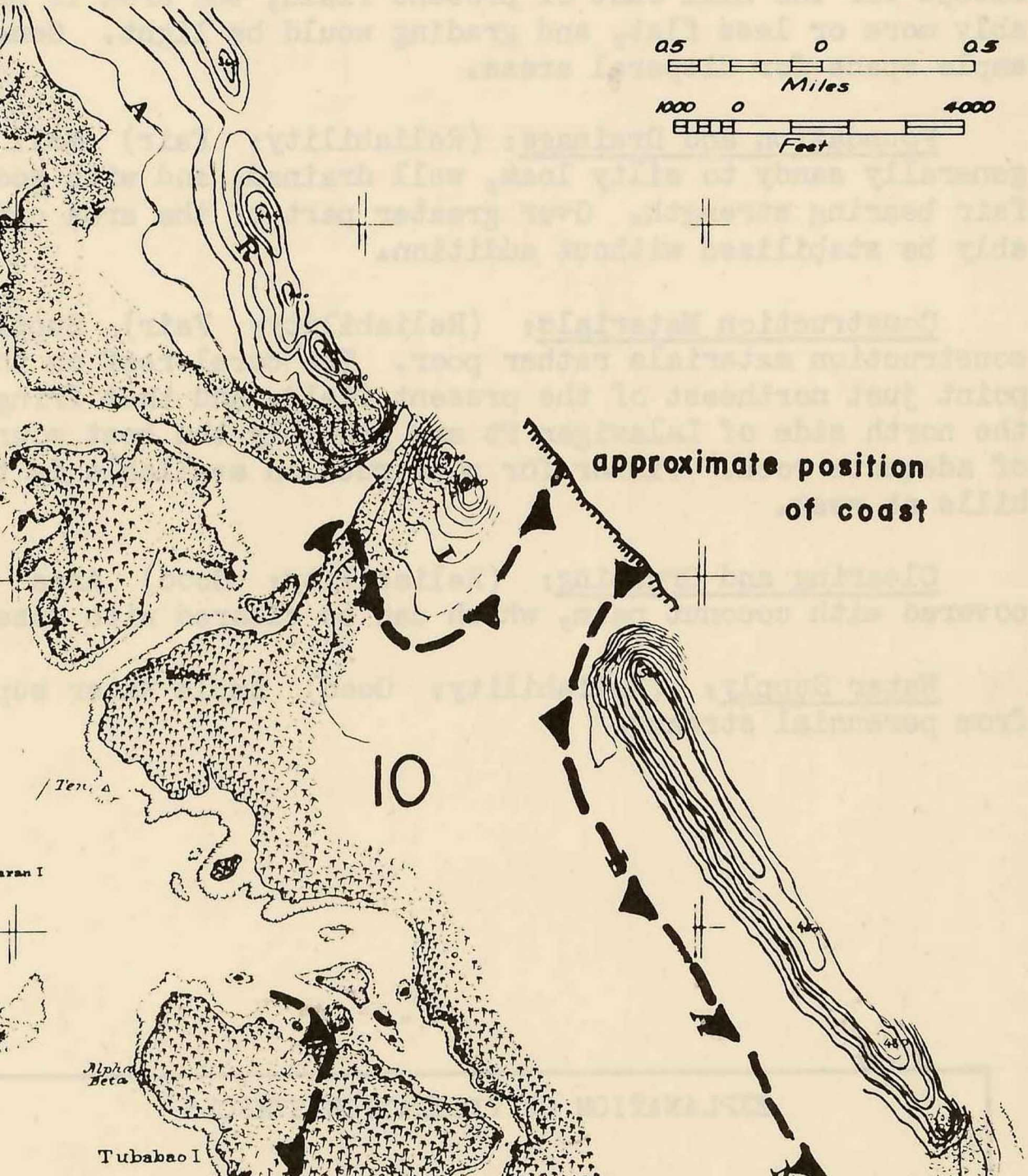
he area is believed to be under
sh and grassland. Coconut-palm
ered.

pply poor. Ground water supply ex-

lands
ally
Areas
f
ed

terials:




0.5 0 0.5
Miles
1000 0 4000
Feet
approximate position
of coast
10
Alpha
Beta
Tubabao I

AREA 12 (CABARASAN)

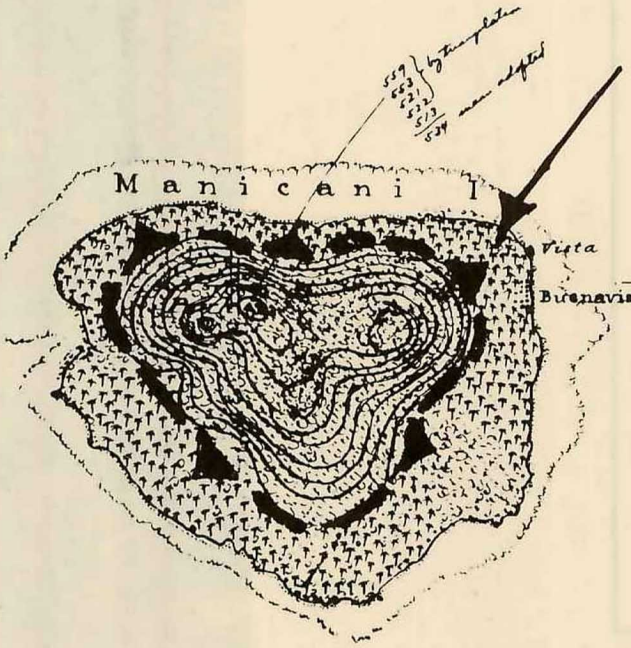
Little information availab
See Suggested Airdrome Sites In
Map and Summary Tabulation of A
drome Site Data.

AREA 13 (CABLANGA)

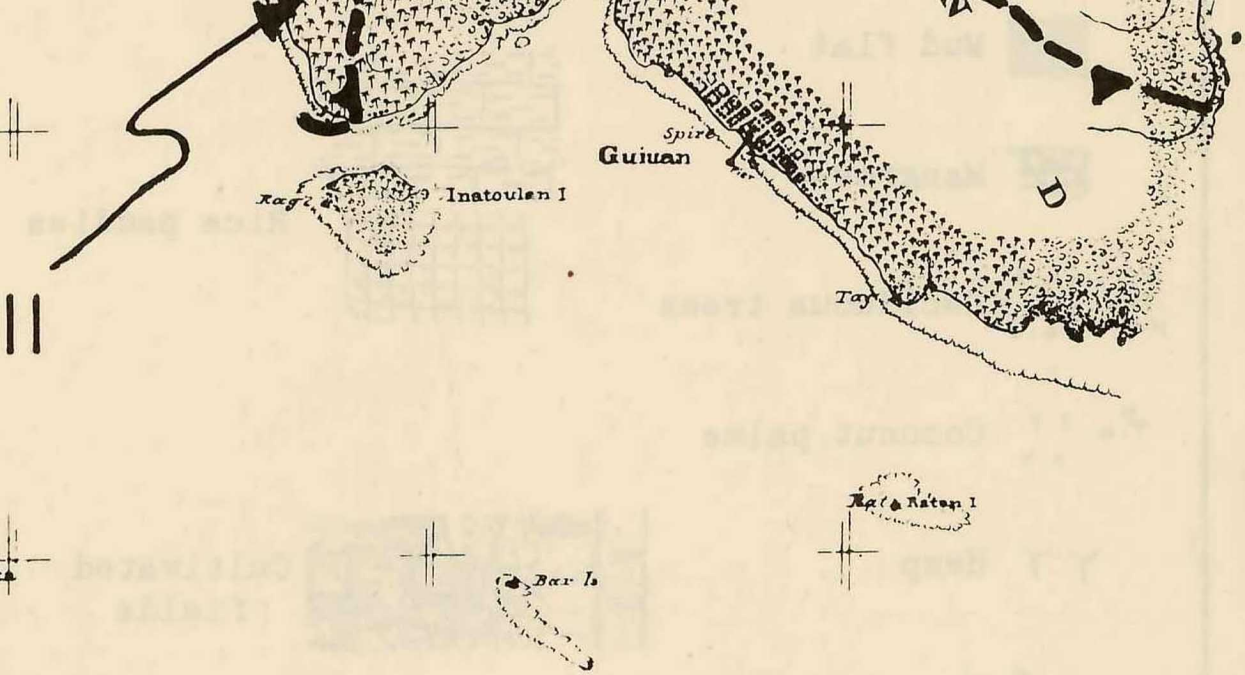
Little information availa
See Suggested Airdrome Sites In
Map and Summary Tabulation of A
drome Site Data.

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AREA 10 (GUIUAN), AND AREA 11 (MANICANI)

Contour Interval 50 feet

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 14 (BASEY)

Summary Evaluation: Good. Ample area for bomber field; grading and clearing minor, but drainage difficult.

Location and Accessibility: Located on the southern coast of Samar Island on the north side of San Pedro bay, at the mouth of the Basey River. Accessible by highway from the west coast of Samar. Some dock facilities at the town of Basey.

Topography and Grading: (Reliability: Good) Extensive deltaic flat, several square miles in area, in vicinity of the town of Basey. The main topographic hazard appears to be a 239-foot hill immediately west of the town. Grading very light. Ample space for 6,000-foot runways and dispersal area; approaches from north may be limited. Concealment probably poor.

Foundation and Drainage: (Reliability: Poor) Soil probably varies from silt to clay loam, somewhat plastic, and with poor to fair bearing strength. Drainage in general probably fair, but locally may require subdrains. Area probably periodically flooded by stream overflow. Subgrade stabilization will require treatment or addition of coarse fractions.

Construction Materials: (Reliability: Poor) Supply of construction stone very poor. Some coral rock may be available at low tide from a small reef one mile west of the town of Basey. Timber also scarce, although possibly some of the mangrove at the mouth of the river is usable.

Clearing and Grubbing: (Reliability: Fair) The area is almost completely under cultivation (see photograph), the nature of which is not known. In any case, however, it is almost certain that all necessary clearing can be done by dozers.

Water Supply: (Reliability: Good) Excellent supply, readily available.

AREA 15 (CALBIGA)

Area not discussed in detail; may be suitable for short fighter strips. Mangrove swamp on west side of area. Data summarized as follows:

Accessibility: Fair

Topography: Fair

Drainage: Fair

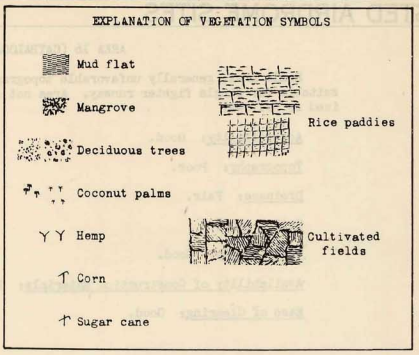
Soil: Good

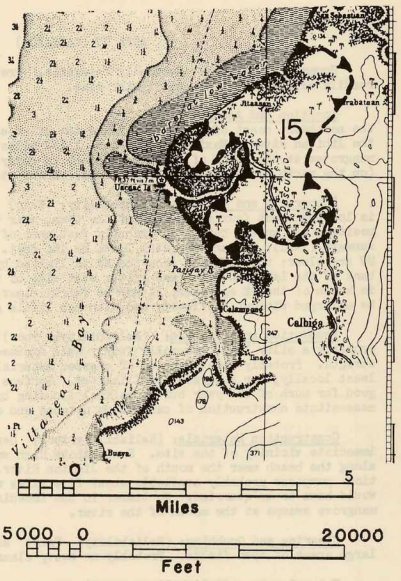
Water Supply: Good

Availability of Construction Materials: Poor

Ease of Clearing: Good

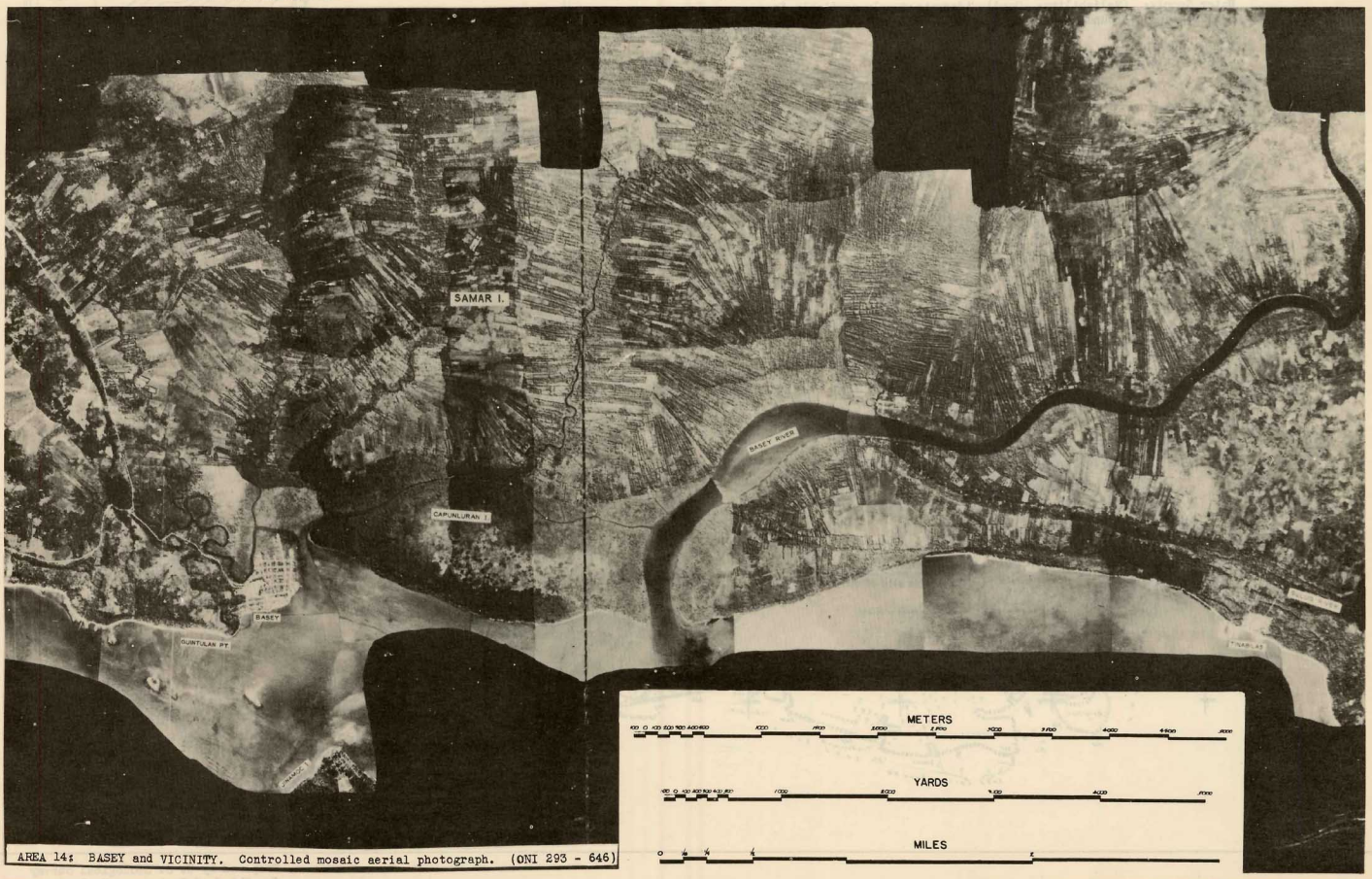
EXPLANATION OF VEGETATION SYMBOLS





AREA 15 (CALBIGA)

Contour Interval 100 feet



AREA 14: BASEY and VICINITY. Controlled mosaic aerial photograph. (ONI 293 - 646)

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE (P.I.)

Summary Evaluation: Good.
minor, but drainage difficult.

Location and Accessibilit
ern coast of Samar Island on t
Basey River. Accessible by hi
facilities at the town of Base

Topography and Grading: (
several square miles in area,
graphic hazard appears to be a
Grading very light. Ample spa
approaches from north may be l

Foundation and Drainage:
silt to clay loam, somewhat pl
Drainage in general probably f
probably periodically flooded
require treatment or addition

Construction Materials:
stone very poor. Some coral r
reef one mile west of the town
some of the mangrove at the mo

Clearing and Grubbing: (
ly under cultivation (see phot
any case, however, it is almos
by dozers.

Water Supply: (Reliabilit

[redacted]

AREA 14 (BASEY)

Ample area for bomber field; grading and clearing

y: Located on the south-
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ghway from the west coast of Samar. Some dock
y.

Reliability: Good) Extensive deltaic flat,
in vicinity of the town of Basey. The main topo-
239-foot hill immediately west of the town.
ce for 6,000-foot runways and dispersal area;
imited. Concealment probably poor.

(Reliability: Poor) Soil probably varies from
astic, and with poor to fair bearing strength.
air, but locally may require subdrains. Area
by stream overflow. Subgrade stabilization will
of coarse fractions.

(Reliability: Poor) Supply of construction
ock may be available at low tide from a small
of Basey. Timber also scarce, although possibly
uth of the river is usable.

Reliability: Fair) The area is almost complete-
ograph), the nature of which is not known. In
t certain that all necessary clearing can be done

y: Good) Excellent supply, readily available.

SUGGESTED AIRDROME SITES

EXPLANATION OF VEGETATION SYMBOLS

Mud flat

Mangrove

Deciduous trees

Coconut palms

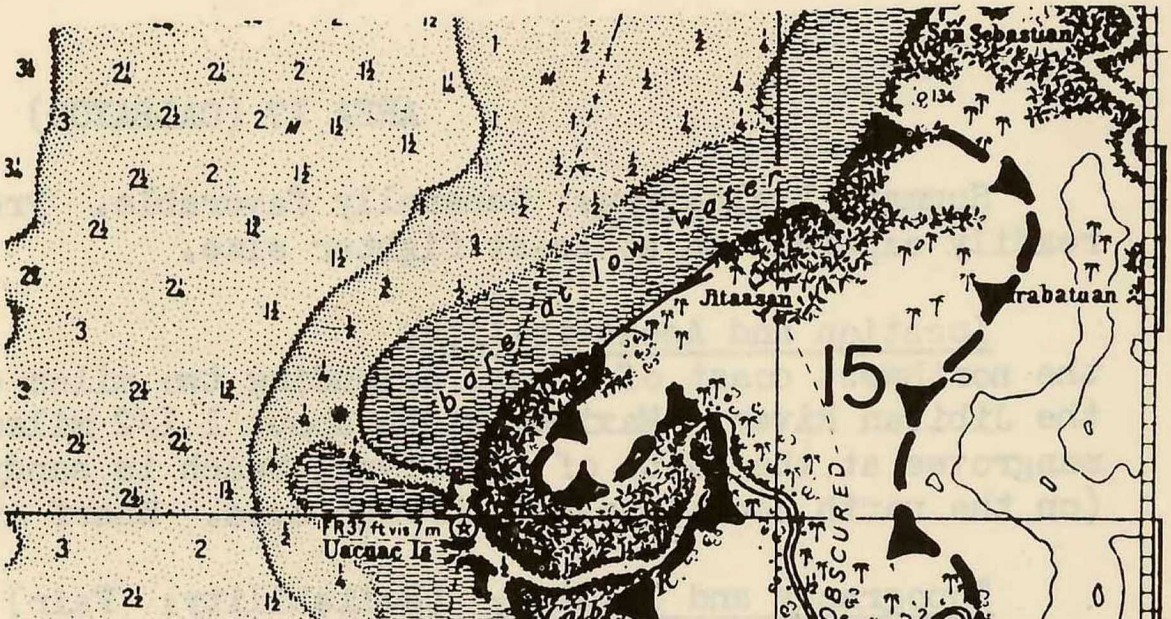
Hemp

Corn

Sugar cane

Rice paddies

Cultivated fields



Area not discussed in deta
Mangrove swamp on west side of

Accessibility: Fair

Topography: Fair

Drainage: Fair

Soil: Good

Water Supply: Good

Availability of Construct

Ease of Clearing: Good



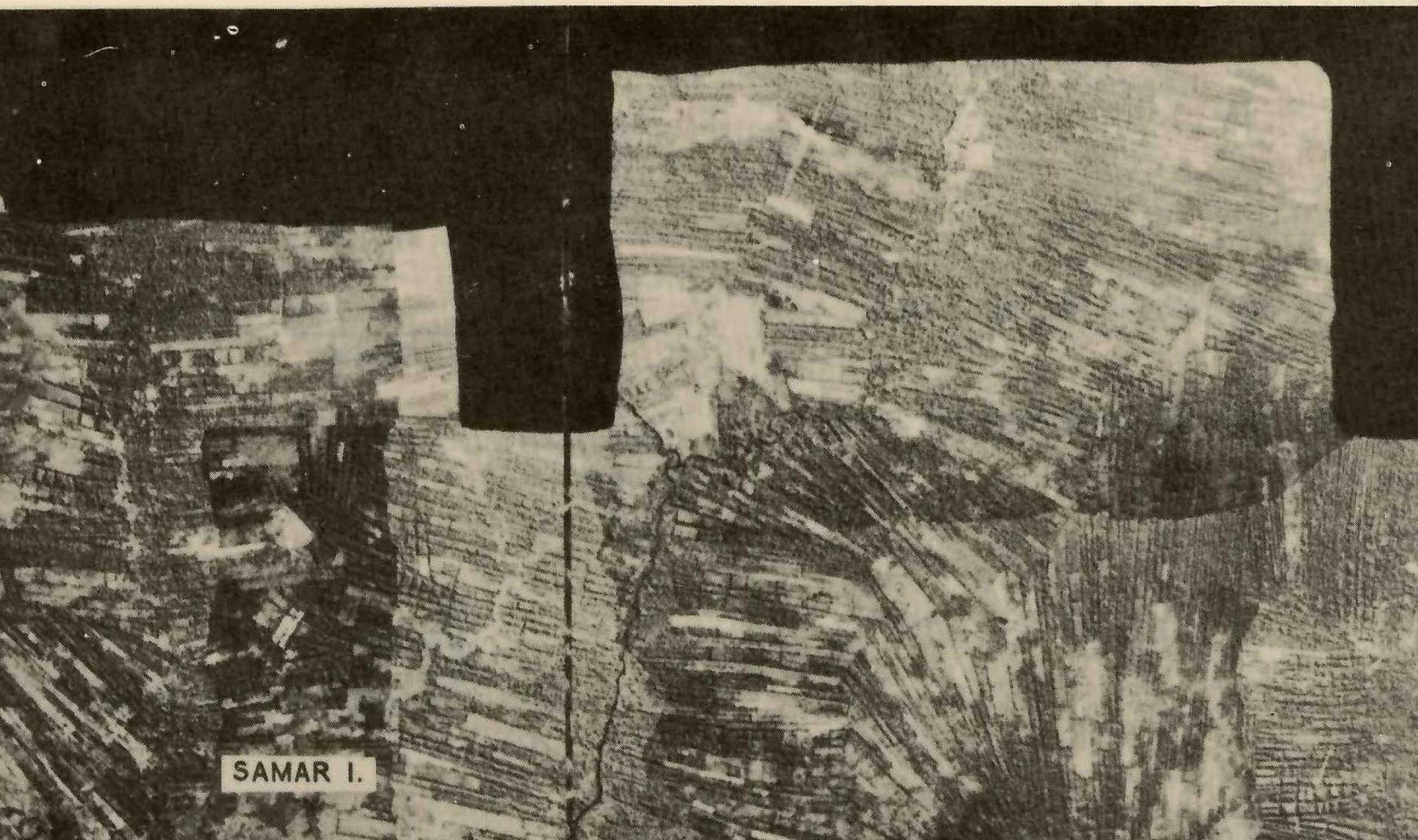
AREA 15 (CALBIGA)

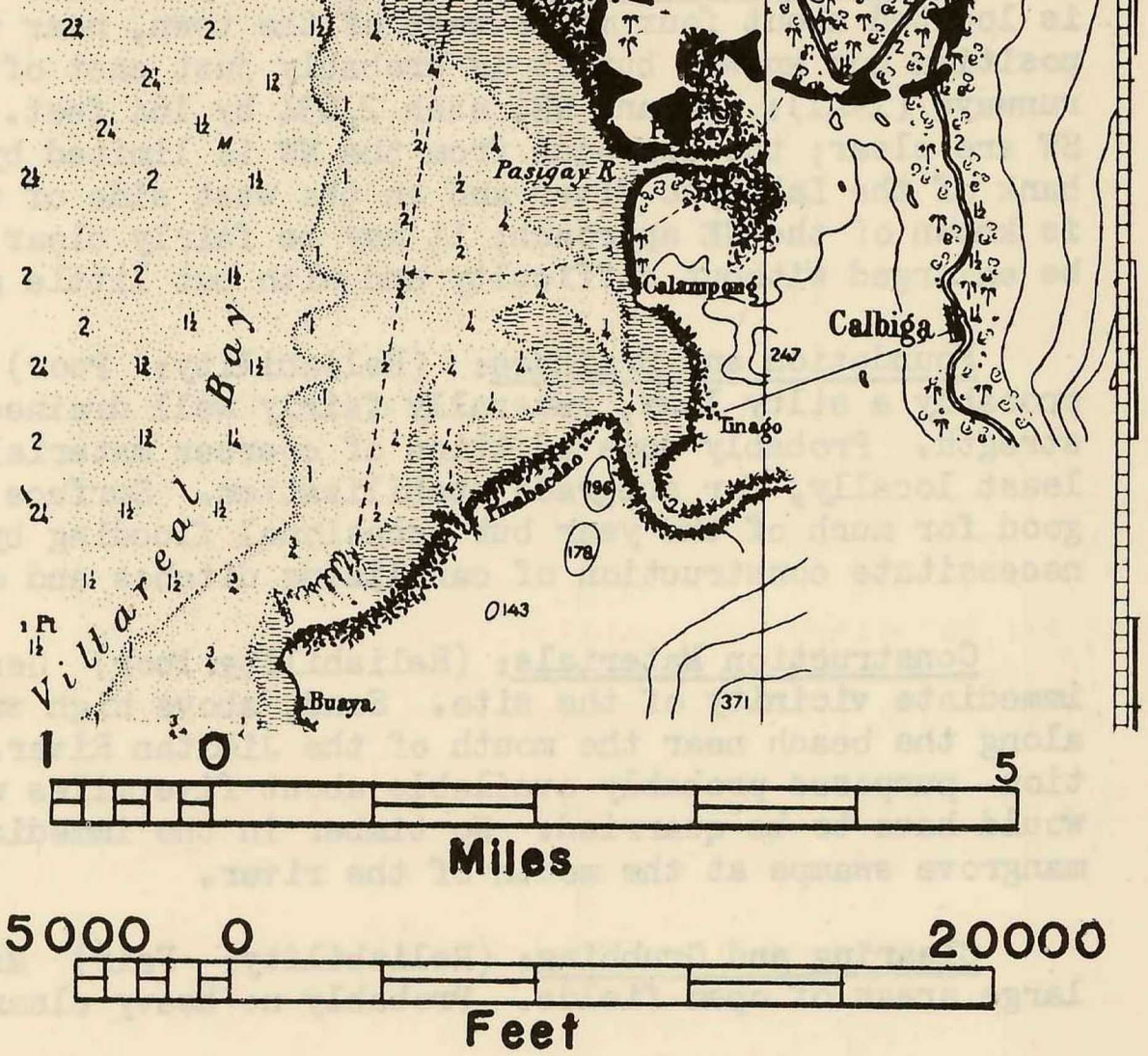
ail; may be suitable for short fighter strips.
area. Data summarized as follows:

AREA 15 (CALBIGA)

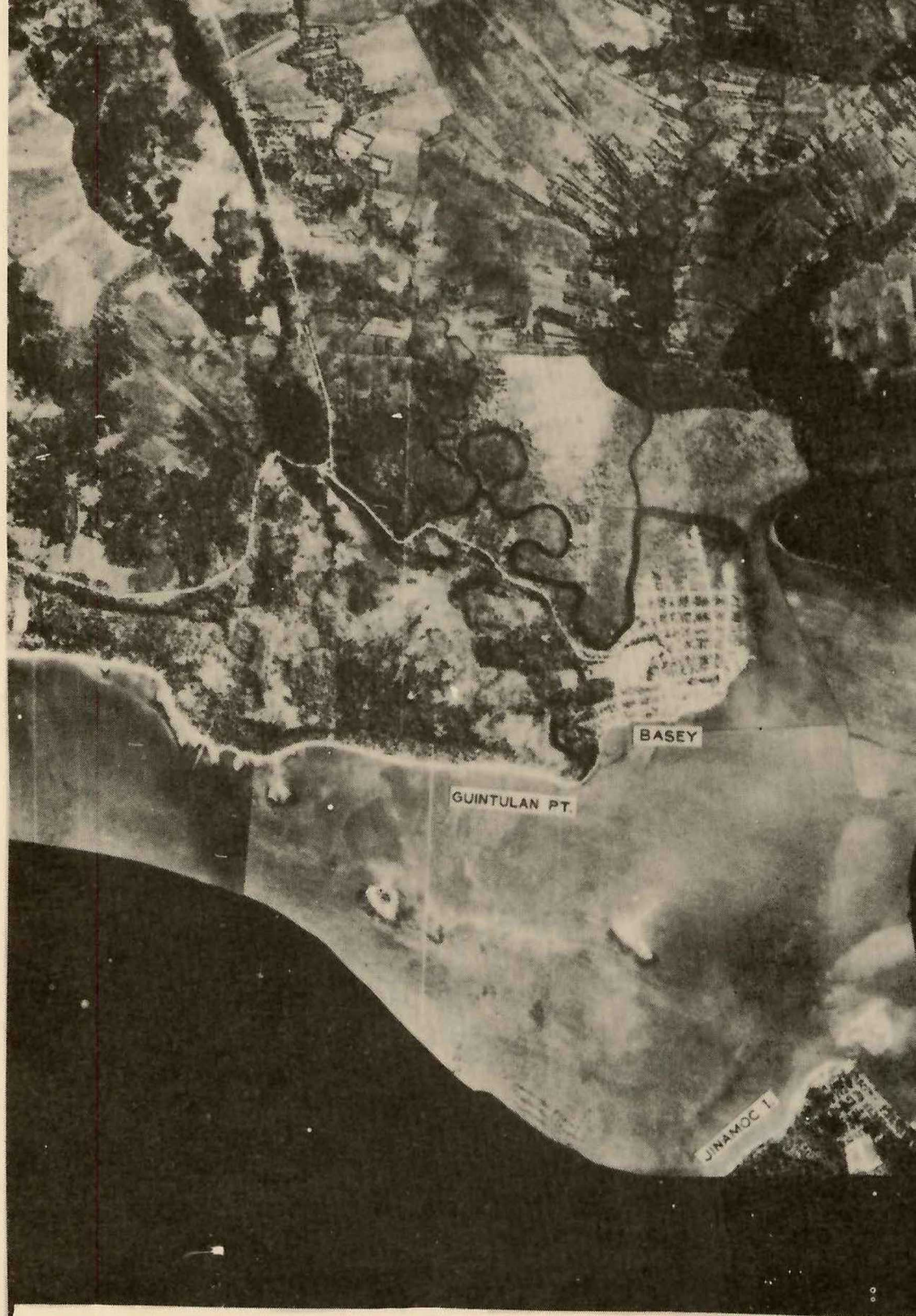
Contour Interval 100 feet

ion Materials: Poor

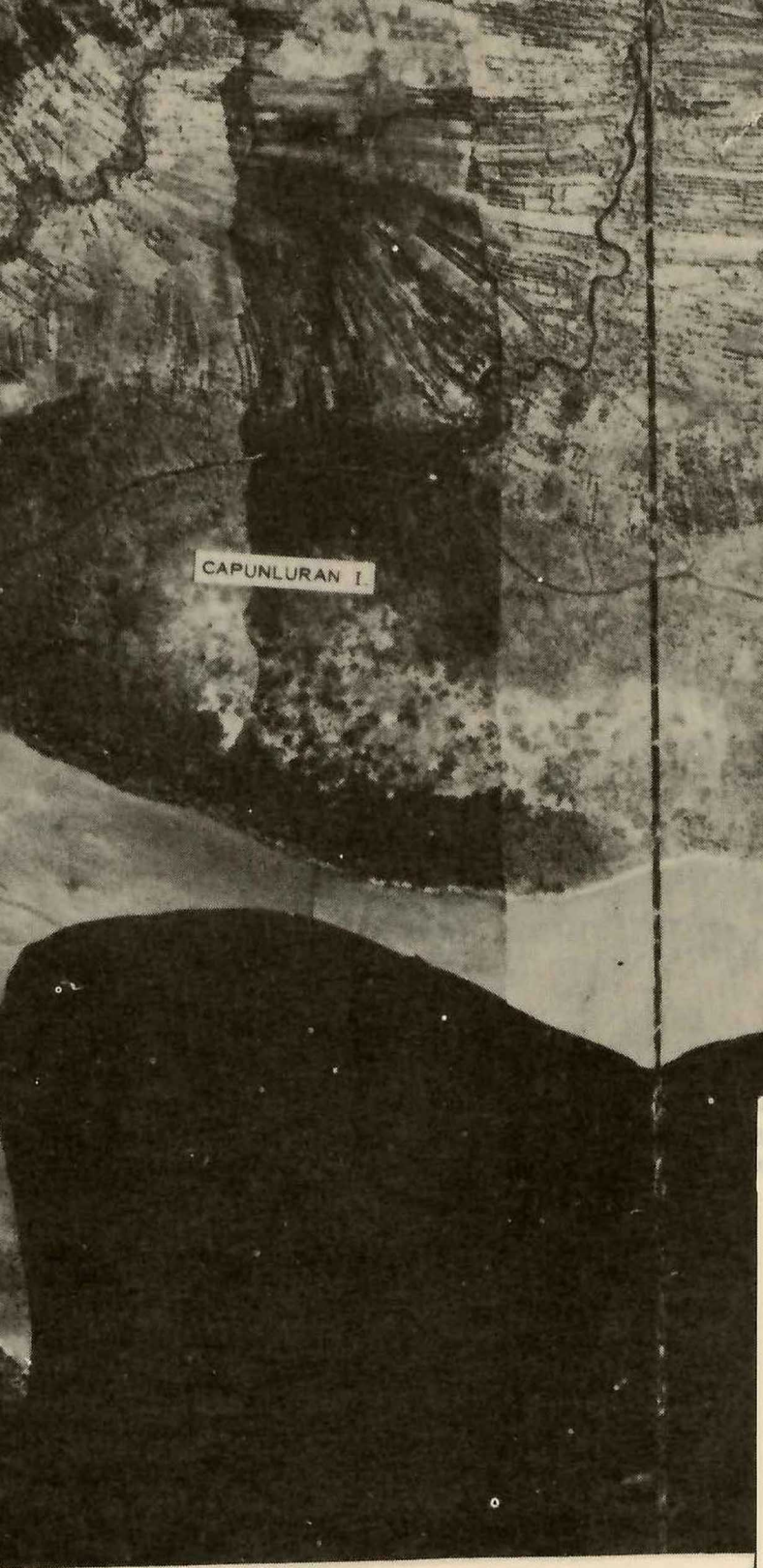


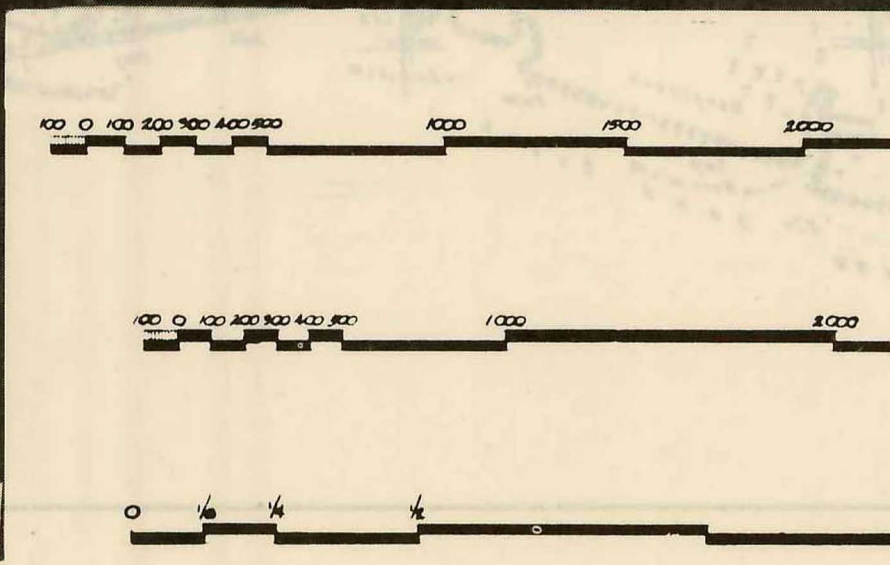

Villareal Bay
Pasigay R
Calampong
Calbiga
Tinago
Pimabaclao
Busaya
0143
247
196
178
371
1 0 5
Miles
5000 0 20000
Feet





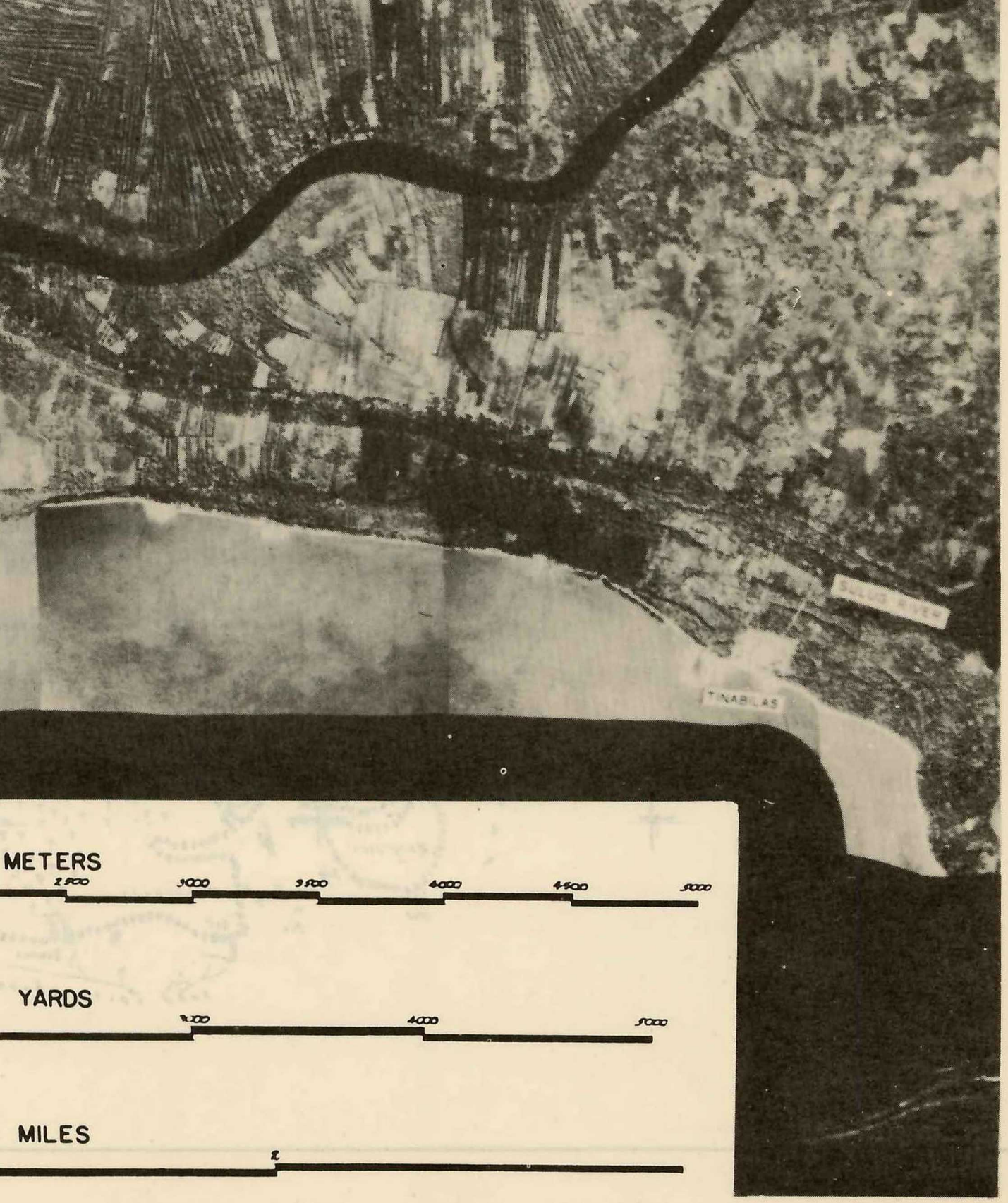
AREA 14: BASEY and VICINITY. Controlled mosaic





aerial photograph. (ONI 293 - 646)

[redacted]



METERS

2500 3000 3500 4000 4500 5000

YARDS

4000 5000

MILES

1

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 16 (CATBALOGAN)

Small area, generally unfavorable topographically; approaches poor. May be suitable for single fighter runway. Area not discussed in detail. Data summarized as follows:

Accessibility: Good.

Topography: Poor.

Drainage: Fair.

Soil: Good.

Water Supply: Good.

Availability of Construction Materials: Poor.

Ease of Clearing: Good.

EXPLANATION OF VEGETATION SYMBOLS

Mud flat

Mangrove

Rice paddies

Deciduous trees

Coconut palms

Hemp

Cultivated fields

Corn

Sugar cane

AREA 17 (CALBAYOG)

Summary Evaluation: Generally favorable. Present field can probably be readily expanded to at least fighter size.

Location and Accessibility: A coastal flat on the northwest coast of Samar, extending two miles eastward from the mouth of the Jibitan River. Maximum width about 1 1/2 miles at the river. Except for mangroves at the mouth of the river, beach is sandy. Highway from Catarman (on the north coast) passes through area. Wharf at Calbayog.

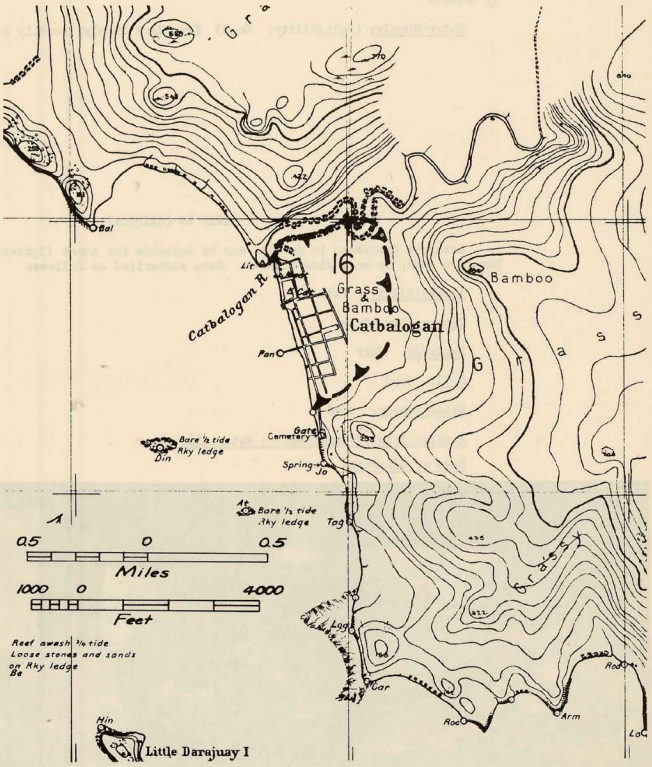
Topography and Grading: (Reliability: Fair) The present Calbayog field is located about four miles west of the town, near the Jibitan River. Exact position not known, but it is probably just east of Trinidad. Field had two runways (1941): NW and NE, each 2,634 by 164 feet. Approaches from the SE and SW are clear; the approach from the NW is limited by low hills on the south bank of the Labouyac River and on the west side of the Jibitan River. Nothing is known of the NE approach; it may be fairly clear. The field probably could be enlarged without difficulty and with but little grading.

Foundation and Drainage: (Reliability: Poor) The soil in this area is probably a silty loam, generally fairly well drained, and with fair bearing stregth. Probably some addition of coarser material will be necessary, at least locally, for subgrade stabilization. Surface drainage probably fair to good for much of the year but occasional flooding by the Jibitan River will necessitate construction of canalizing ditches and drains.

Construction Materials: (Reliability: Poor) Generally poor supply in the immediate vicinity of the site. Sand, above high water level, can be obtained along the beach near the mouth of the Jibitan River. Good rock for construction purposes probably available about five miles west along the coast. This would have to be quarried. No timber in the immediate area unless from the mangrove swamps at the mouth of the river.

Clearing and Grubbing: (Reliability: Fair) Mainly coconut palms, with large areas of open fields. Probably no heavy clearing necessary.

Water Supply: (Reliability: Good) Adequate supply available from perennial streams. Ground water supply good.

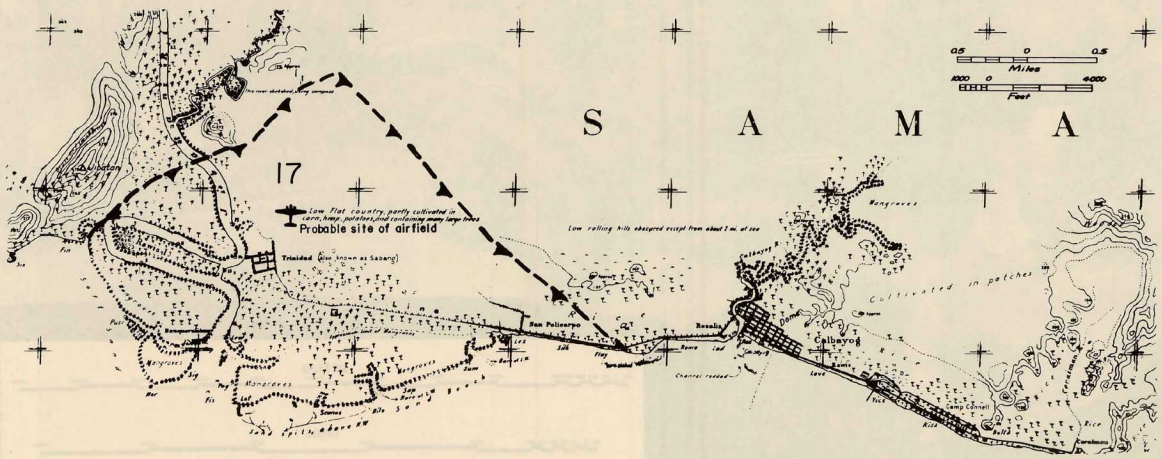


AREA 16 (CATBALOGAN)

Contour Interval 50 feet

AREA 17 (CALBAYOG)

Contour Interval 50 feet



Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army

SUGGESTED AIRDROME SITES

AREA 16 (CATBALO

Small area, generally unfavorable topogr
suitable for single fighter runway. Area not
ized as follows:

Accessibility: Good.

Topography: Poor.

Drainage: Fair.

Soil: Good.

Water Supply: Good.

Availability of Construction Materials:

Ease of Clearing: Good.

AREA 17 (CALBAYOG)

Summary Evaluation: Generally favorable. Pres
readily expanded to at least fighter size.

Location and Accessibility:
the northwest coast of Samar, extending two miles ea
the Jibitan River. Maximum width about 1 1/2 miles
mangroves at the mouth of the river, beach is sandy.
(on the north coast) passes through area. Wharf at

Topography and Grading: (Reliability: Fair)

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raphically; approaches poor. May be
t discussed in detail. Data summar-

Poor.

EXPL

Mud fl

Mangro

Decidu

Coconu

Hemp

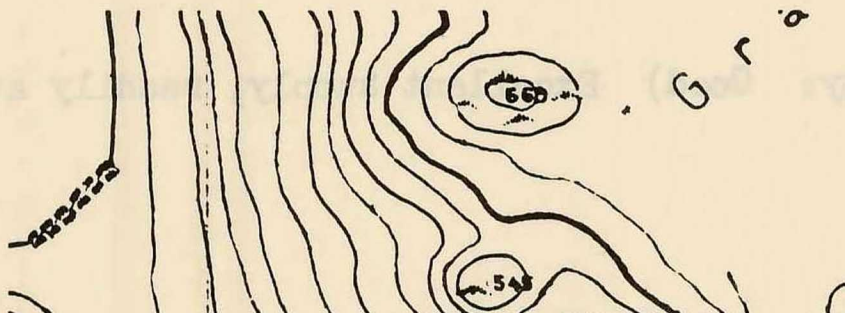
Corn

Sugar

sent field can probably be

A coastal flat on
astward from the mouth of
at the river. Except for
. Highway from Catarman
Calbayog.

The present Calbayog field



SAMAR AND LEYTE (P.I.)

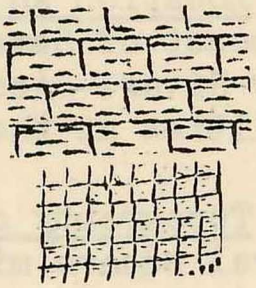
ANATION OF VEGETATION SYMBOLS

at

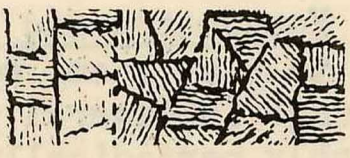
ve

ous trees

t palms



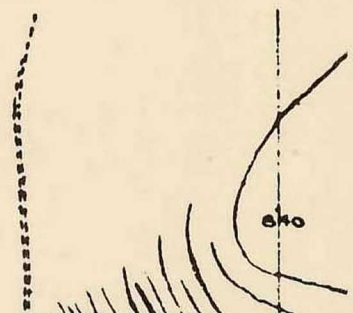
Rice paddies



Cultivated fields

cane





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position not known, but it is probably just east of
runways (1941): NW and NE, each 2,634 by 164 feet.
SW are clear; the approach from the NW is limited by
bank of the Labouyao River and on the west side of t
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Foundation and Drainage: (Reliability: Poor)
probably a silty loam, generally fairly well drained
stregth. Probably some addition of coarser material
least locally, for subgrade stabilization. Surface
good for much of the year but occasional flooding by
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Construction Materials: (Reliability: Poor) Gen
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along the beach near the mouth of the Jibitan River.
tion purposes probably available about five miles w
would have to be quarried. No timber in the immedia
mangrove swamps at the mouth of the river.

Clearing and Grubbing: (Reliability: Fair) Ma
large areas of open fields. Probably no heavy clear

Water Supply: (Reliability: Good) Adequate s
perennial streams. Ground water supply good.

he Jibitan River. Exact
Trinidad. Field had two
Approaches from the SE and
low hills on the south
he Jibitan River. Nothing
. The field probably could
grading.

The soil in this area is
d, and with fair bearing
will be necessary, at
drainage probably fair to
the Jibitan River will
drains.

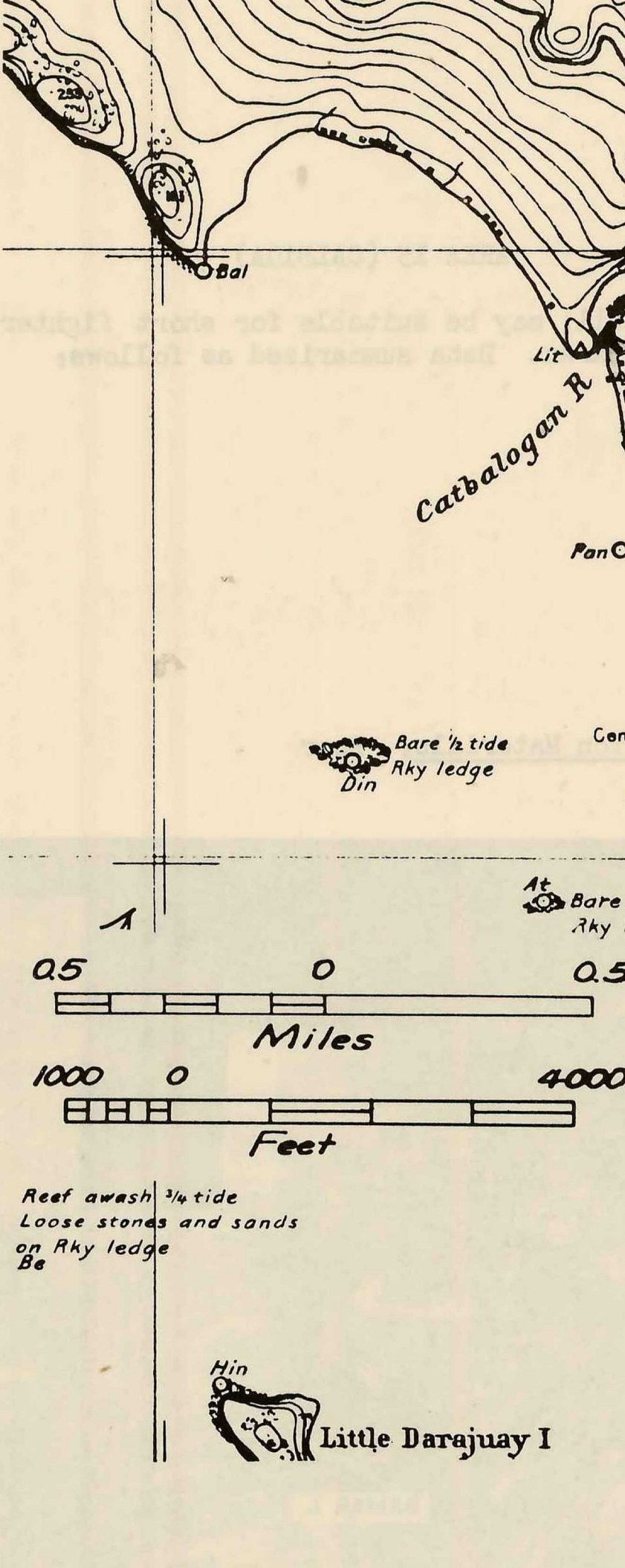
erally poor supply in the
ter level, can be obtained
. Good rock for construc-
est along the coast. This
te area unless from the

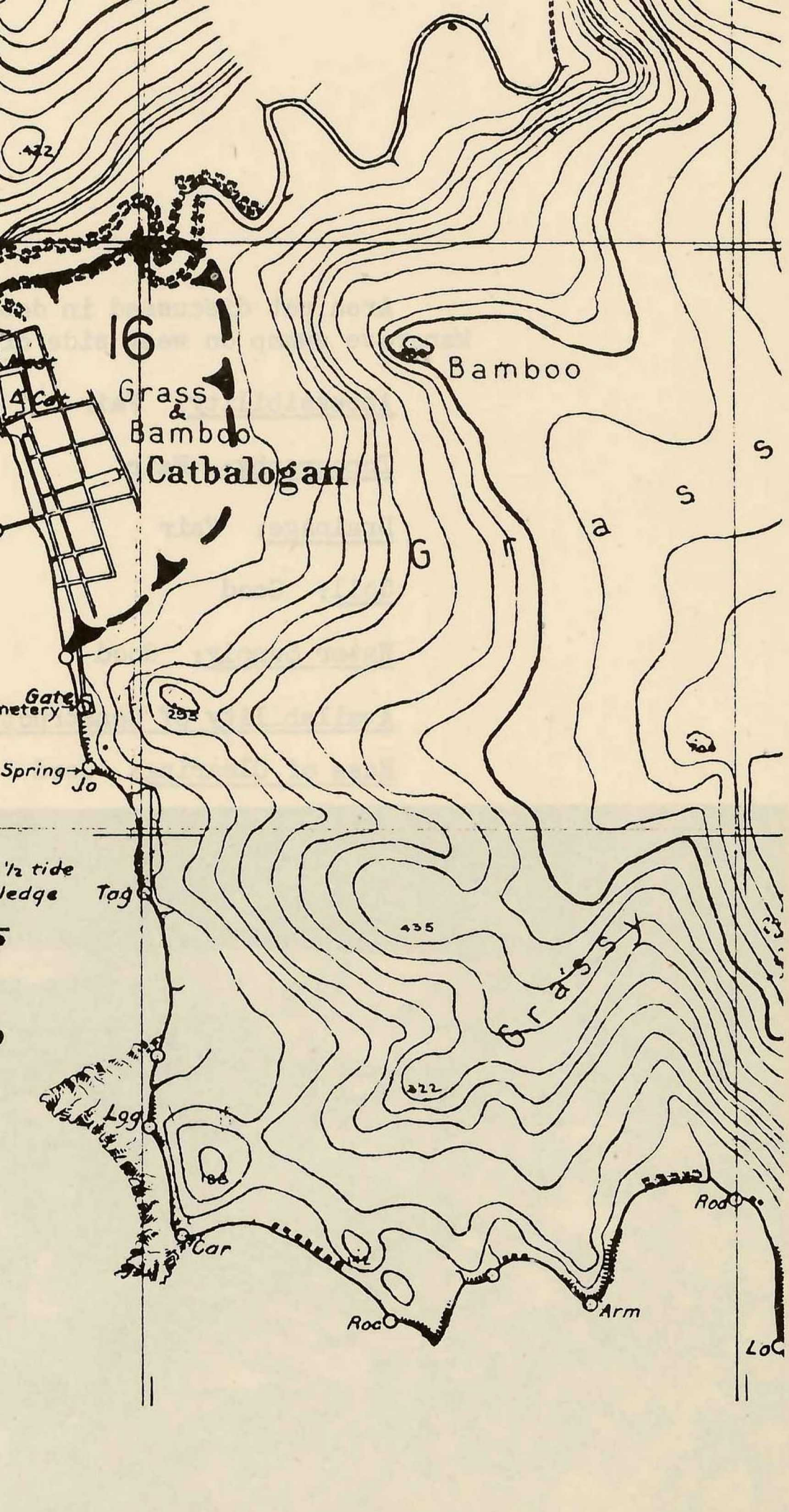
inly coconut palms, with
ring necessary.

upply available from

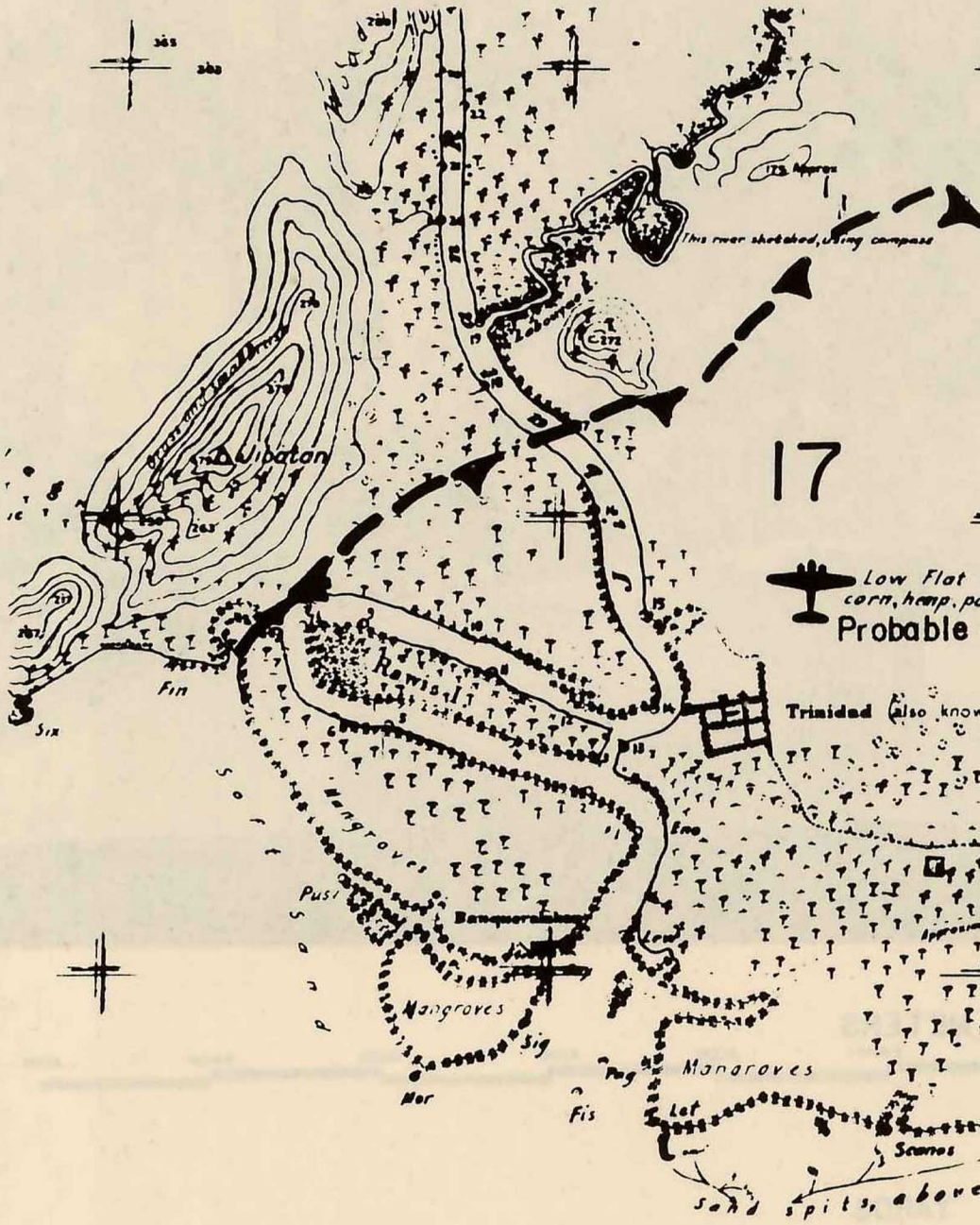
(AREA 16 (CATBALOGAN)

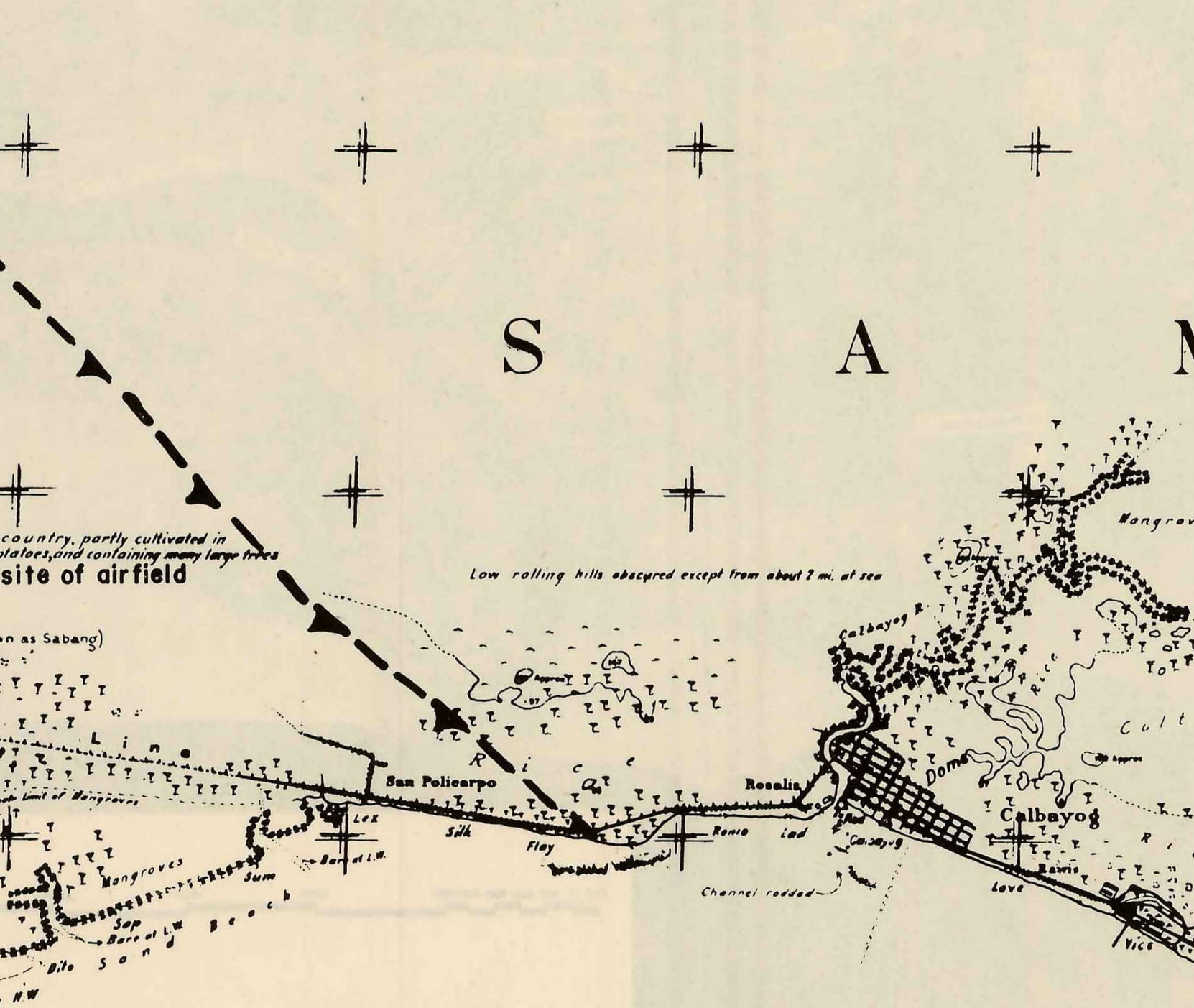
Contour Interval 50 feet



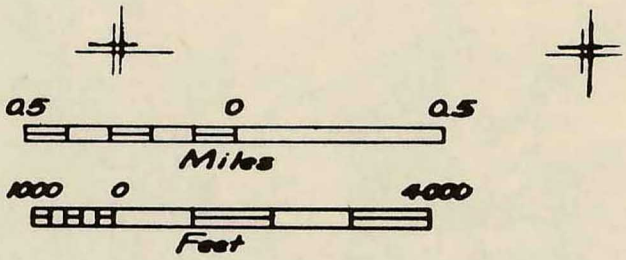

16
Grass
&
Bamboo
Catbalogan
Bamboo
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Gate
metery
Spring
Jo
Tag
Log
Car
Roc
Arm
Rod
Lo
252
435
422

Contour Interval 50 feet

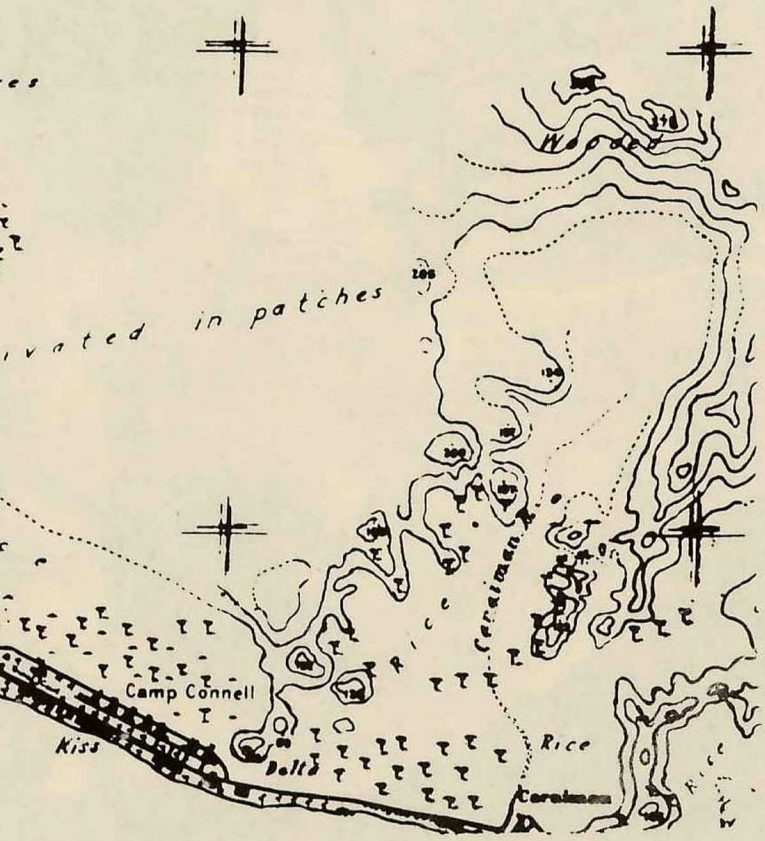




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Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army

AREA 18 (TANAUAN)

Summary Evaluation: Many excellent bomber sites possible; construction easy.

Location and Accessibility: Includes the extensive southeastern part of northeast lowland of Leyte, the coastal strip from Palo north to Cataisan Pt, and the coastal strip as far south as Abuyog. Area over 200 square miles, traversed by several good roads. Almost the entire coastline bordered by sand beaches; some of streams navigable by launches for short distances inland. Port facilities at Tacloban at north end of area. In 1941, there was an airfield on Cataisan Pt, near Tacloban, with 2,700-foot runways oriented N-S and NE. In February 1944, seven airfields were reported to be under construction; approximate locations shown by symbol on map.

Topography and Grading: (Reliability: Good). Most of the area is flat plain which rises gently toward the foothills to the southwest. Plain is broken by three major groups of hills: (1) about three miles south of Palo; (2) along the coast between Tanauan and Tolosa; (3) a range, 1,000-feet high, extending from Labirana (on the coast) northwesterly to St. Vincente. Many large streams flow eastward across the plain; these streams flow in shallow troughs, generally bordered by broad, low natural levees up to 20 feet high, with wide areas of interstream flats. Grading will be a problem only when the sites chosen extend into the small stream channels; the interstream areas should give ample space for full-size bomber runways and dispersal areas. Concealment generally poor, although locally fair to good in coconut palm groves along streams and near coast. On north coastal plain, the Tacloban field on Cataisan Pt (see view) could be expanded by using the center of the peninsula for the N-S runway, but dispersal area is very limited.

Foundation and Drainage: (Reliability: Fair) For purposes of description, Area 18 can be subdivided as follows:

1. Lowland plains
   a) Interstream areas
   b) Areas adjacent to stream channels.
2. Coastal Plains.

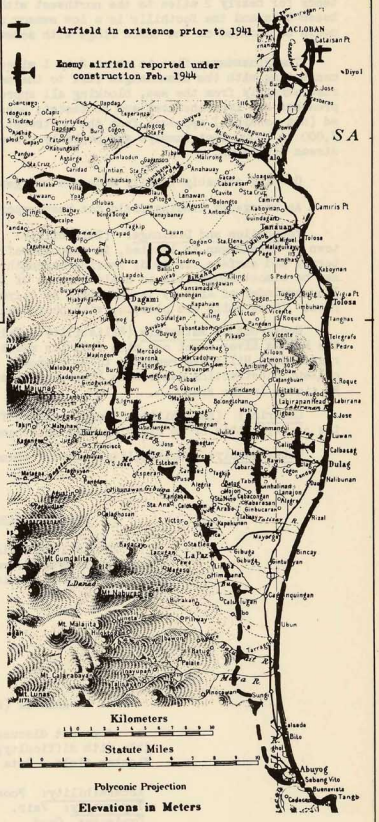
The interstream areas of the lowland plain are very level, broken only by occasional hills rising sharply above the general level. Soil is clay or silt loam, poorly to moderately well drained, probably locally with interlayered sandy material. Much of the area will be wet rice paddies. Surface drainage probably fair but ditches will be necessary to canalize occasional stream overflow and excess rainfall. The soil probably remains more or less plastic for greater part of the year because of poor internal drainage, so that permanent fields will require extensive subdrains and addition of coarse fractions for subgrade stabilization. Parallel to the stream channels, there is generally a belt of sandy, well-drained soils, varying in width from a few tens to several hundreds of feet. Locally, coarse sand and possibly gravel may be present. This sandy material will often be banked up in low natural levees which will tend to pond overflow water in interstream areas. Drainage (both surface and internal) and bearing strength will be fair to good on levees but it is unlikely that sites of sufficient size can be located wholly on such soil; most sites will extend into the more clayey interstream areas.

The coastal plain areas are underlain by sandy loam, usually becoming more sandy toward the coast and more clayey toward the foothills. Cataisan Pt (Tacloban airfield) is probably typical of the near shore coastal plain. The soil here is sandy and well-drained except in small depressions which are practically at sea level. Because of the lack of sufficient altitude, it may prove virtually impossible to drain some areas of inner coastal plain.

Construction Materials: (Reliability: Good) Supply of construction materials is generally poor. Poor-grade stone is quarried near Tanauan (dark-green, soft, sheared rock), near Palo (hardened shale), and near Tacloban; all the quarries accessible by road. Sand and gravel available from most of streambeds near the foothills, 10 to 15 miles from the coast. Some fine sand available from the beach, particularly from points such as that east of Tacloban (Cataisan Pt). No timber for construction in this part of the island; Samar appears to be the closest source.

Clearing: (Reliability: Good) The greater part of the area is either under cultivation (rice, corn, and other crops) or covered by cogon grass. Coconut palms on the low hills, near the streams, and along the coast. Clearing problems minor, generally very subordinate to drainage; all necessary clearing can be done with dozers.

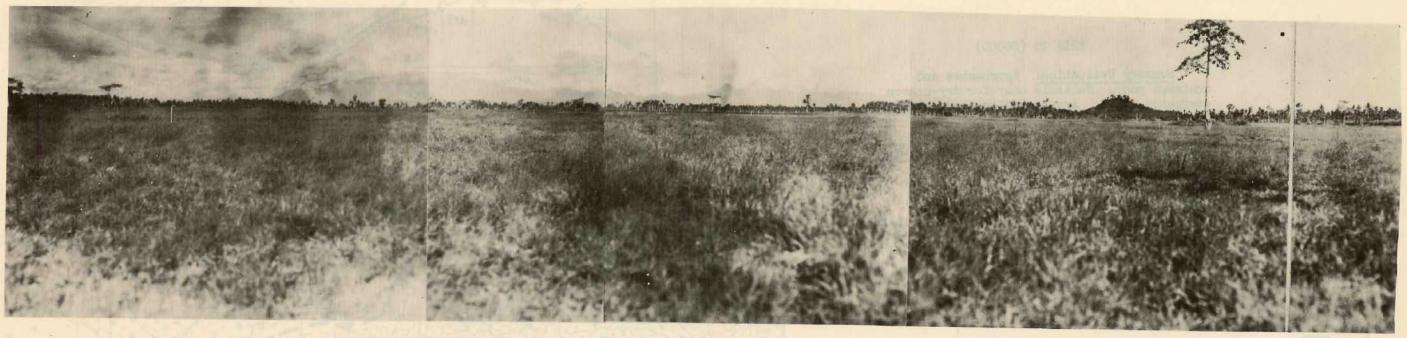
Water Supply: (Reliability: Good) Abundant water, readily available from numerous streams. Abundant ground water; easily developed.



AREA 18 (TANUAAN)



Tacloban airfield on Cataisan Point (northern tip AREA 18). Tacloban in middle distance. View to northwest. (ONI 1657574)



AREA 18. Panoramic view (approximately 90°), looking south (left) to west (right). Volcanic mountains in background. View from near town of Palo (part of AREA 18). (ONI 315,014 - 015)



Panoramic view of southeastern part of northeast lowland of Leyte from near Burauen. (Part of AREA 18). Center N 45 E, taken through approximately 135 degrees. (ONI 315-023, 024, 025)

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE(P.I.)

AREA 18 (TANAUAN)

Summary Evaluation: Many excellent bomber sites pos
struction easy.

Location and Accessibility:
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coastal strip from Palo north to Cataisan Pt, and the coa
far south as Abuyog. Area over 200 square miles, travers
good roads. Almost the entire coastline bordered by sand
of streams navigable by launches for short distances inla
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stream flats. Grading will be a problem only when the si
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limited.

Foundation and Drainage: (Reliability: Fair) For
description, Area 18 can be subdivided as follows:

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   a) Interstream areas

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(b) Areas adjacent to stream channels.

2. Coastal Plains.

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SUGGESTED AIRDROME SITES

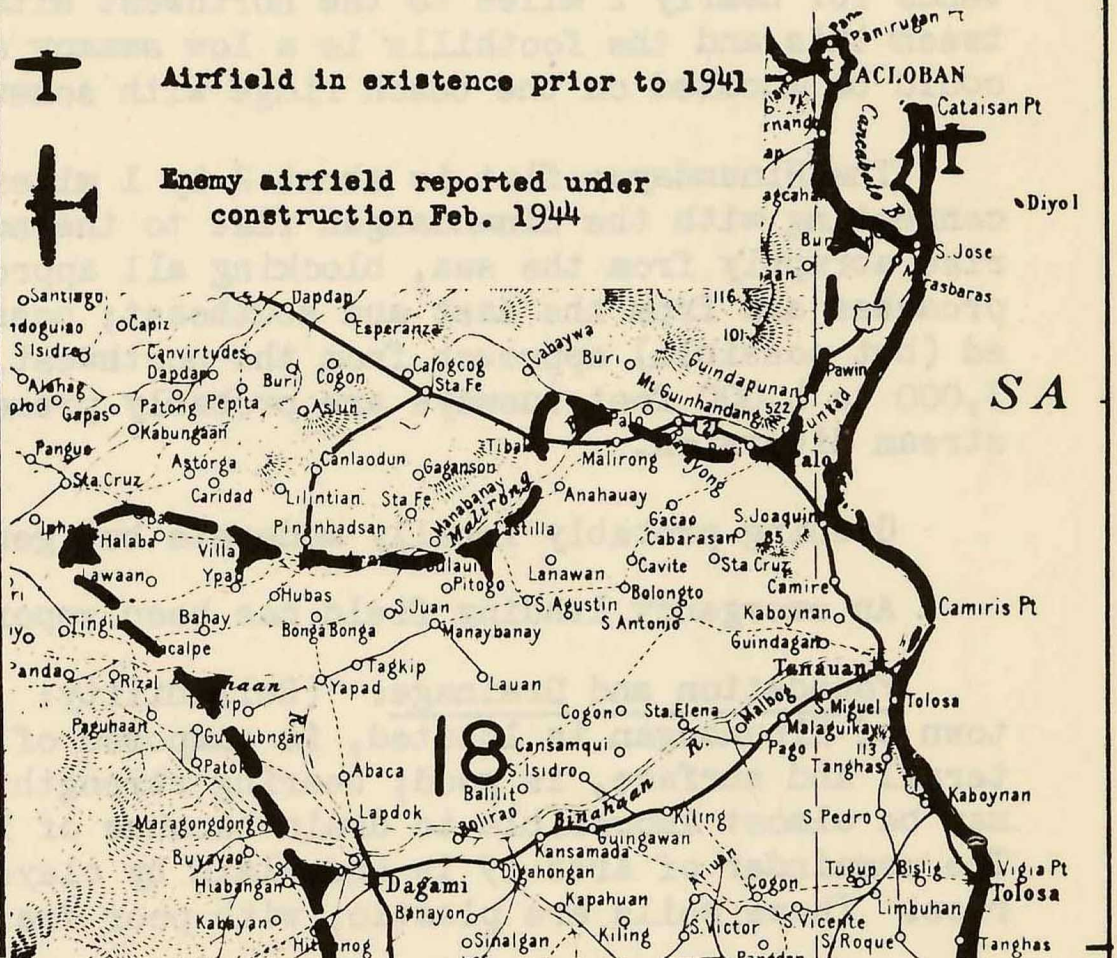
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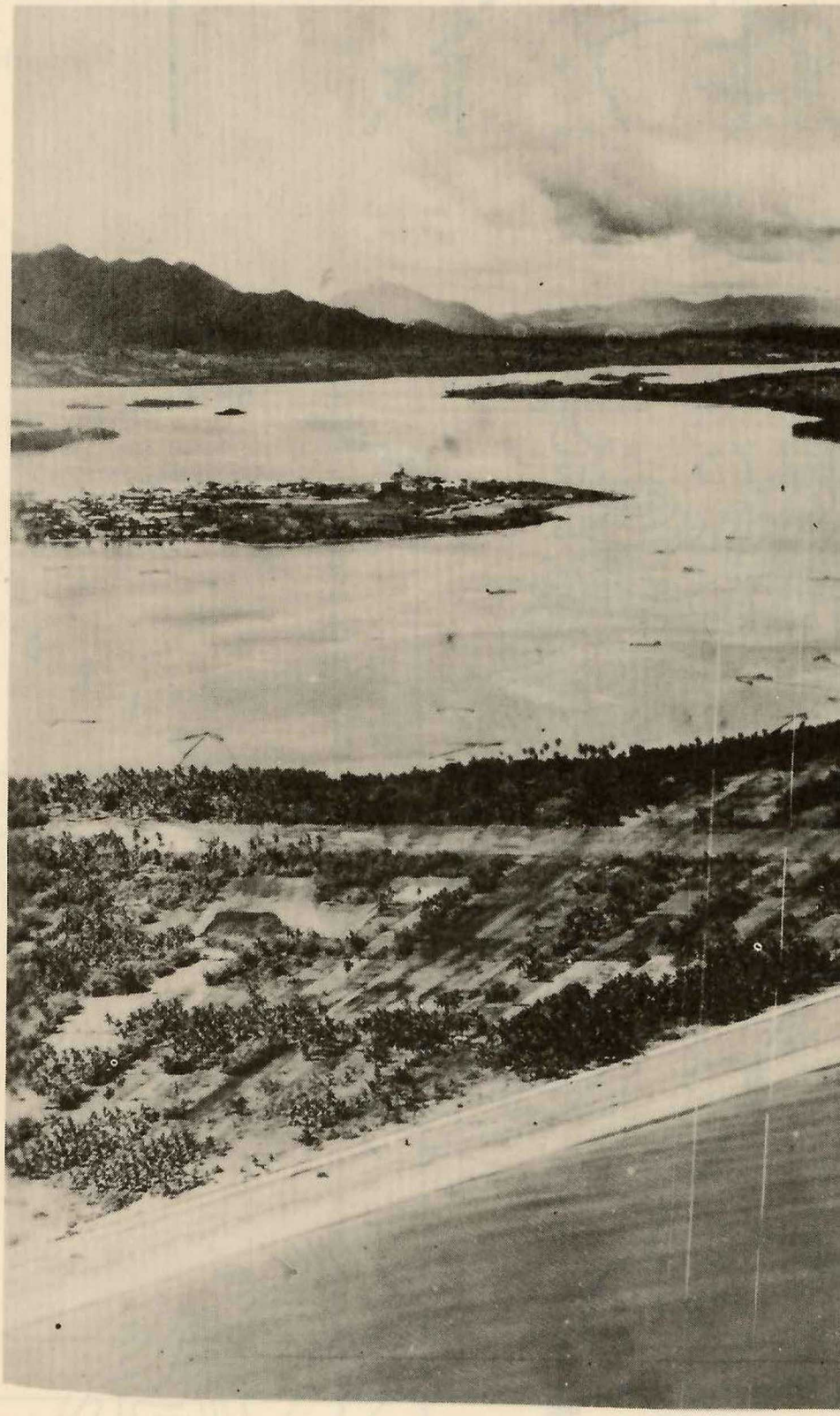
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Tacloban airfield on Cataisan Point (
View to northwest. (ONI 1657574)

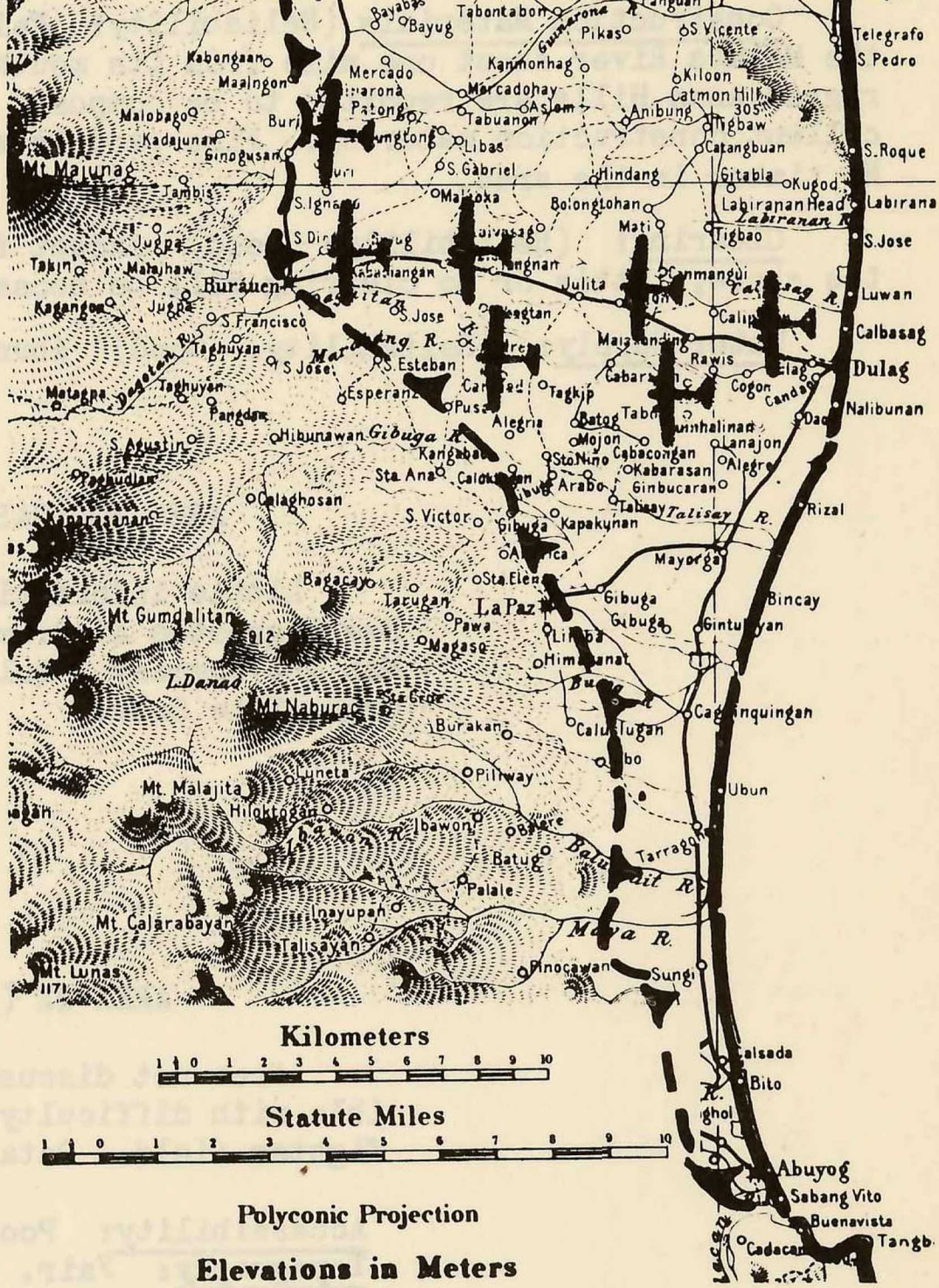




AREA

northern tip AREA 18). Tacloban in middle distance.

A 18 (TANUAAN)

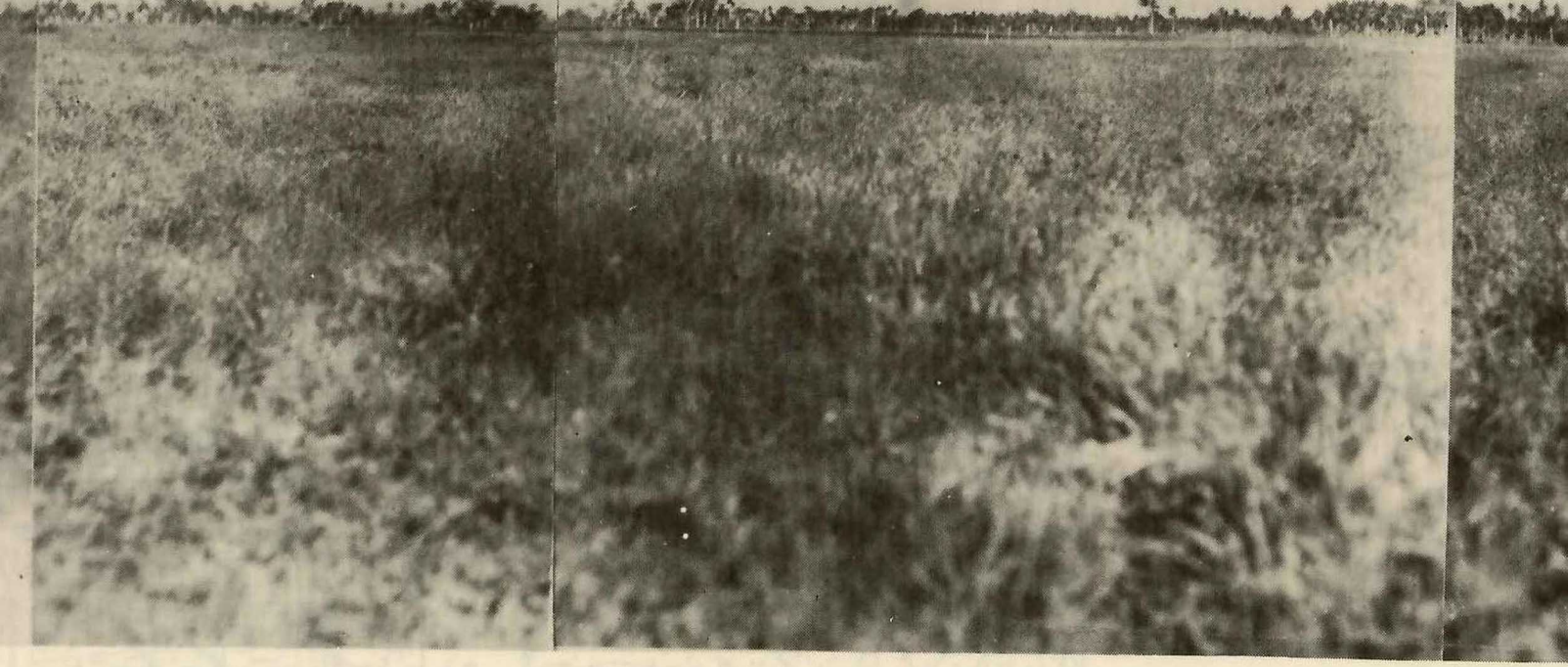

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Mt. Nabuyac
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Dulag
Abuyog
Bito
Calsada
Mayorga
Julita
Jugpa
Tabontabon
Bayug
Kabongaan
Mercado
Kanmonhag
Marcadohay
Patong
Tabuanon
Libas
S. Gabriel
Malobago
Kadajunan
Ginogusan
Tambis
Takin
Malauhaw
Kagangan
S. Francisco
S. Jose
Esperanza
Pangdan
Hibunawan
Gibuga R.
Kangabao
Sta. Ana
Calaghosan
S. Victor
Kapakunan
Bagacay
Tarugan
Pawa
Magasa
Sta. Cruz
Burakan
Luneta
Pilliway
Hilohtogan
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Batug
Palale
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Candag
Nalibunan
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Luwan
Calbasag
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Mati
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S. Vicente
Pikas
Telegrafo
S. Pedro
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Maya R.
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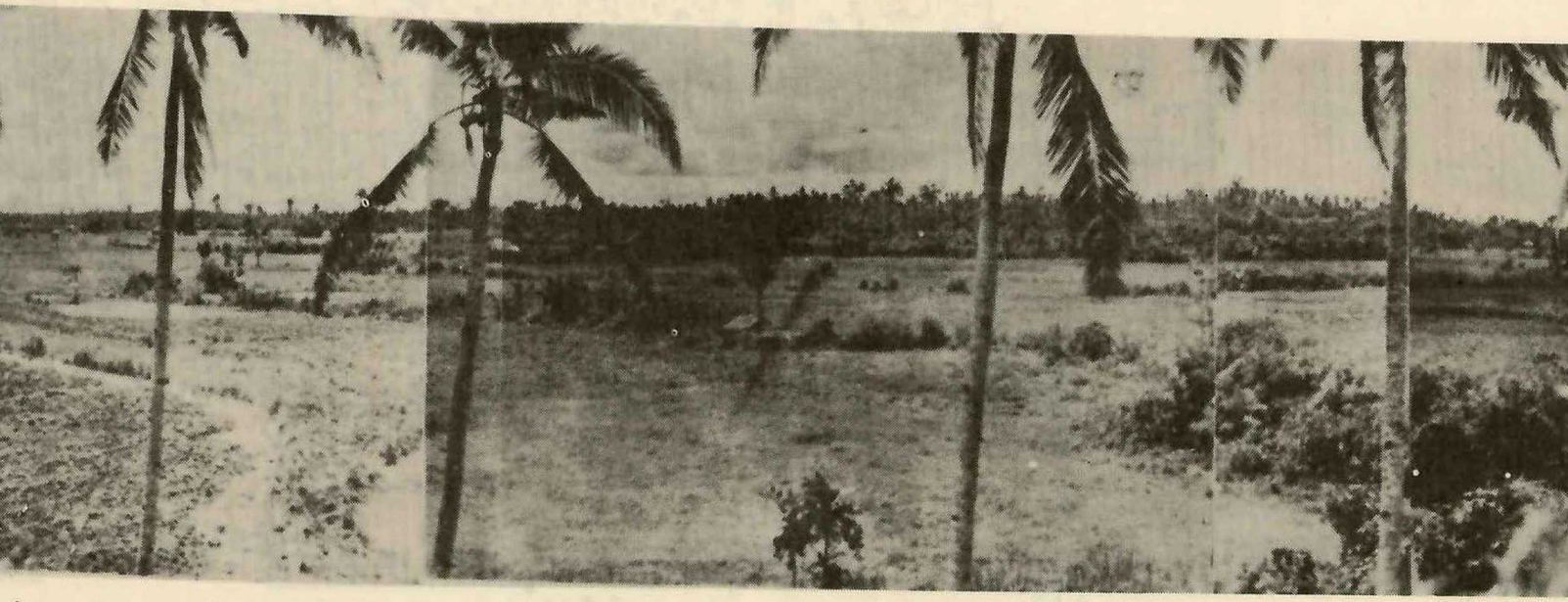
AREA 18.
mountain



Panoram
AREA 18



Panoramic view (approximately 90°), looking south (left) to west (righ
s in background. View from near town of Palo (part of AREA 18). (ONI 31

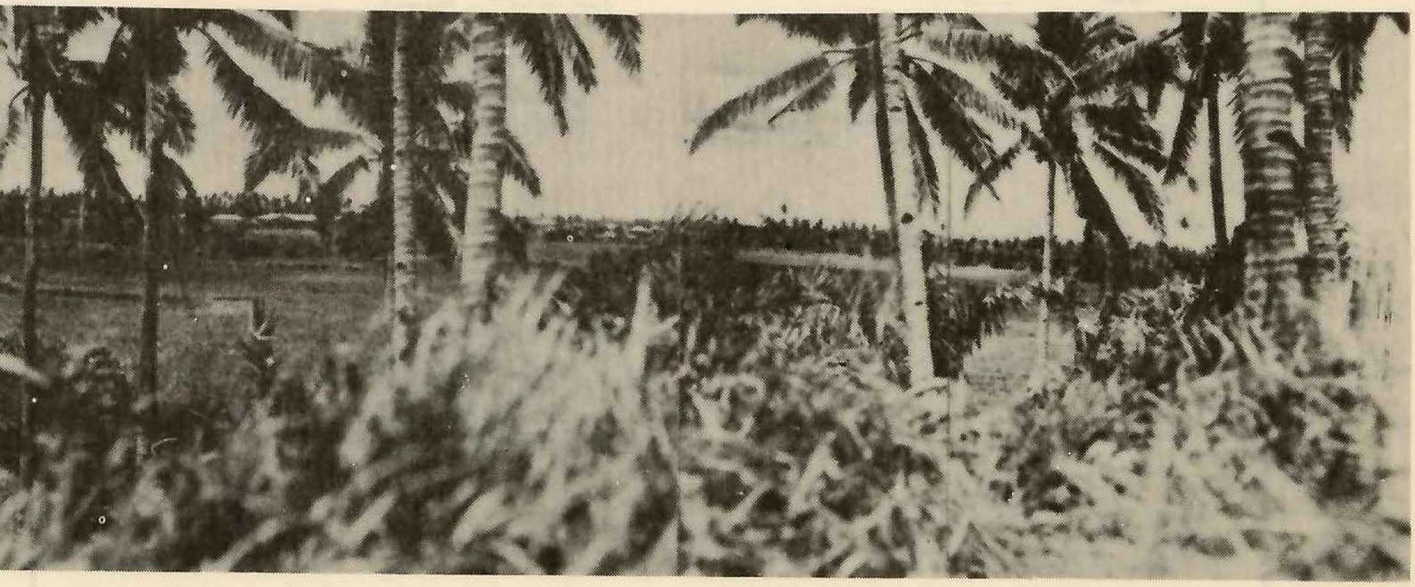


ıic view of southeastern part of northeast lowland of Leyte from near Bur
3). Center N 45 E, taken through approximately 135 degrees. (ONI 315-02

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t). Volcanic
5,014 - 015)



auen. (Part of
3, 024, 025)

AREA 19 (HINUNANGAN)

Summary Evaluation: At least one bomber site with nearly clear approaches; several sites for fighter fields with limited approach.

Location and Accessibility: On the southeast coast of Leyte. A coastal and deltaic flat extending from town of Kanipaan to the town of Hinundayan, with a total length of about 11 1/2 miles and a maximum width of 2 miles. The coastal road from Cabalian (Area 20) passes through the area but stops ten miles northwest of Hinunangan. Sandy beach fronts both the Hinunangan and Hinundayan flats, and launches can enter the Malaga River at high tide. A small wharf is reported at Hinundayan.

Topography and Grading. (Reliability: Good) The outlined area consists of two low coastal flats (the Hinunangan and Hinundayan) connected by a narrow inland valley. The Hinunangan flat is approximatedly 3 1/2 miles long and ranges from 1 to 2 miles in width. It is bounded on the west by hills which rise abruptly to elevations of about 1,000 feet. The town is located on a low beach ridge, probably not over 20 feet in elevation, which extends for nearly 2 miles to the northwest with a width of one-fourth to half a mile. Between this and the foothills is a low swampy area, largely planted in rice. A NW runway could be located on the beach ridge with somewhat limited approaches from both directions.

The Hinundayan flat is about 2 by 1 miles in area, extending westward from the town and connecting with the Hinandangan flat to the northwest. North of the town, the Anan Hills rise abruptly from the sea, blocking all approaches from that direction. The only open approaches are from the east and southeast; possibly one for two sites that would have limited (but possible) approach from the northwest. Within the area several sites suitable for 3,000 to 4,000 foot runways are probably present but larger sites would probably require stream diversion.

Grading probably locally moderate but generally light. Concealment will be poor.

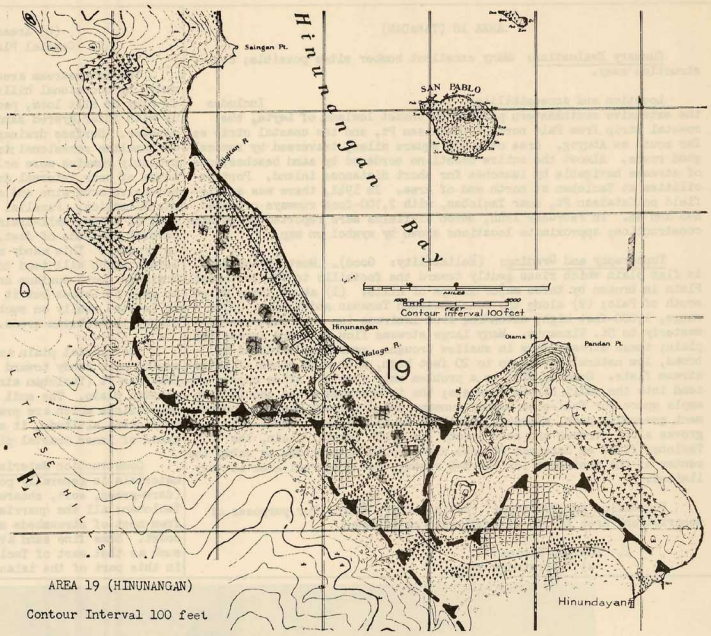
An emergency landing field has been reported near Hinundayan, but no details are known.

Foundation and Drainage: (Reliability: Fair) The low coastal ridge, on which the town of Hinunangan is located, is composed of well-drained sandy soil. Drainage, both internal and surface, is good; bearing strength fair to good. The inner flat at Hinunangan may be almost impossible to drain because of its low elevation, except in driest months. The remainder of Area 19 is underlain by clayey or silty soil, much of which is planted in rice. These soils are plastic, with poor drainage and low bearing strength.

Construction Materials (Reliability: Fair) Gravel and sand reported in the bed of the Malaga River about one mile from its mouth; probably available from other streams. The rugged Anan Hills are reported to be composed of hard coral limestone, which provides excellent construction material. Fine sand is available from the beach and beach ridge, No timber in the area.

Clearing: (Reliability: Good) Except for coconut groves along the streams and near the shore, little or no clearing will be necessary.

Water Supply: (Reliability: Good) Abundant water readily available.



AREA 19 (HINUNANGAN)
Contour Interval 100 feet

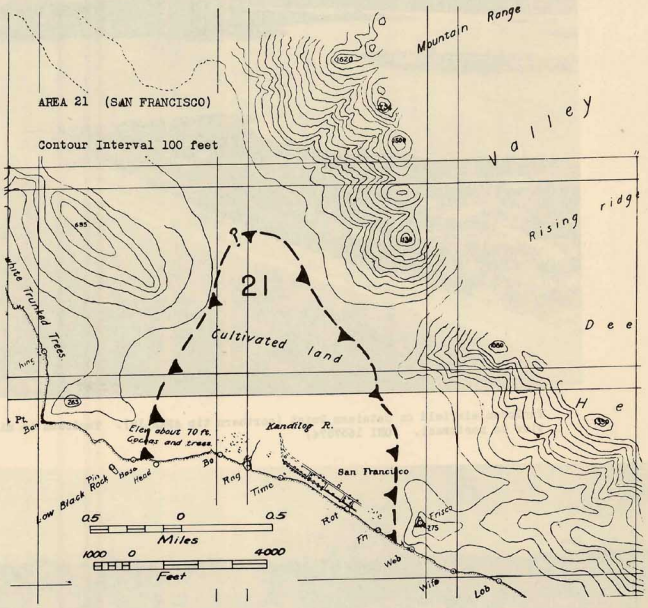
AREA 20 (CABALIAN)

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 21 (SAN FRANCISCO)

Area not discussed in detail. Site accessible with difficulty; otherwise suitable for fighter field. Data summarized as follows:

Accessibility: Poor.
Topography: Fair.
Drainage: Good.
Soil: Good.
Water Supply: Good.
Availability of Construction Materials: Fair.
Ease of Clearing: Fair.



AREA 21 (SAN FRANCISCO)
Contour Interval 100 feet

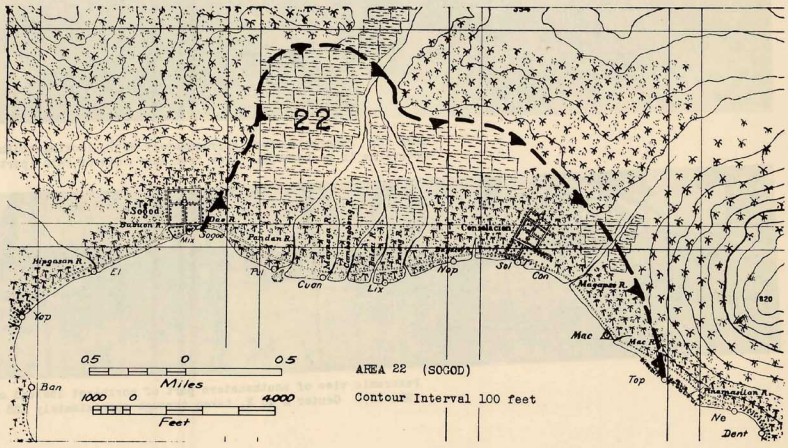
AREA 22 (SOGOD)

Summary Evaluation: Approaches and drainage poor. Suitable only for dry-season emergency field. Area not discussed in detail. Data summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Poor.
Soil: Poor.
Water Supply: Good.
Availability of Construction Materials: Good.
Ease of Clearing: Good.

EXPLANATION OF VEGETATION SYMBOLS

- Mud flat
- Mangrove
- Deciduous trees
- Coconut palms
- Hemp
- Corn
- Sugar cane
- Rice paddies
- Cultivated fields



AREA 22 (SOGOD)
Contour Interval 100 feet

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

SUGGESTED AIRDROME SITES

AREA 19 (HINUNANGAN)

Summary Evaluation: At least one bomber site with nea
sites for fighter fields with limited approach.

Location and Accessibility: On the southeast coast of
flat extending from town of Kanipaan to the town of Hinunda
11 1/2 miles and a maximum width of 2 miles. The coastal r
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tide. A small wharf is reported at Hinundayan.

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stream diversion.

Grading probably locally moderate but generally light.

An emergency landing field has been reported near Hinu

Foundation and Drainage: (Reliability: Fair) The lo
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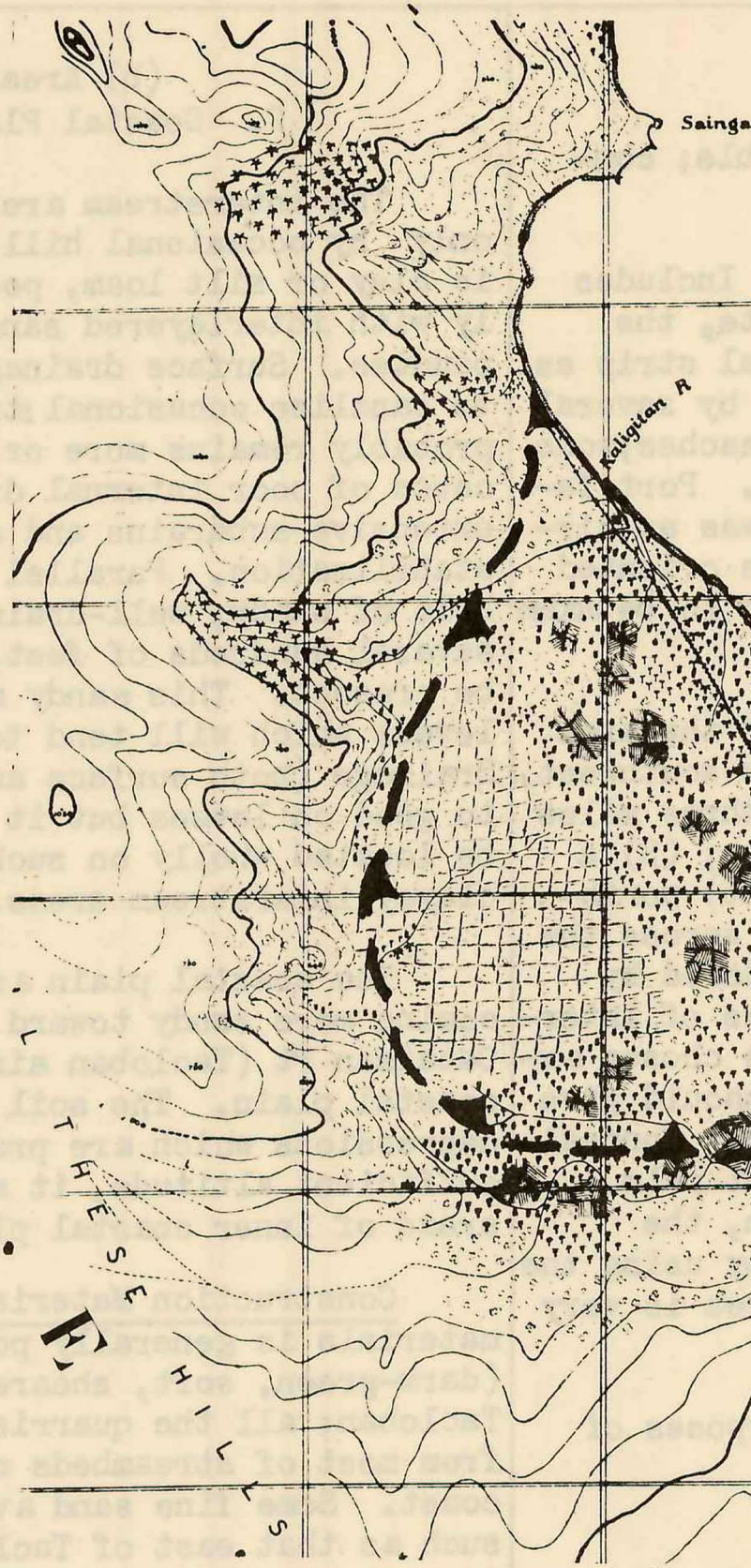
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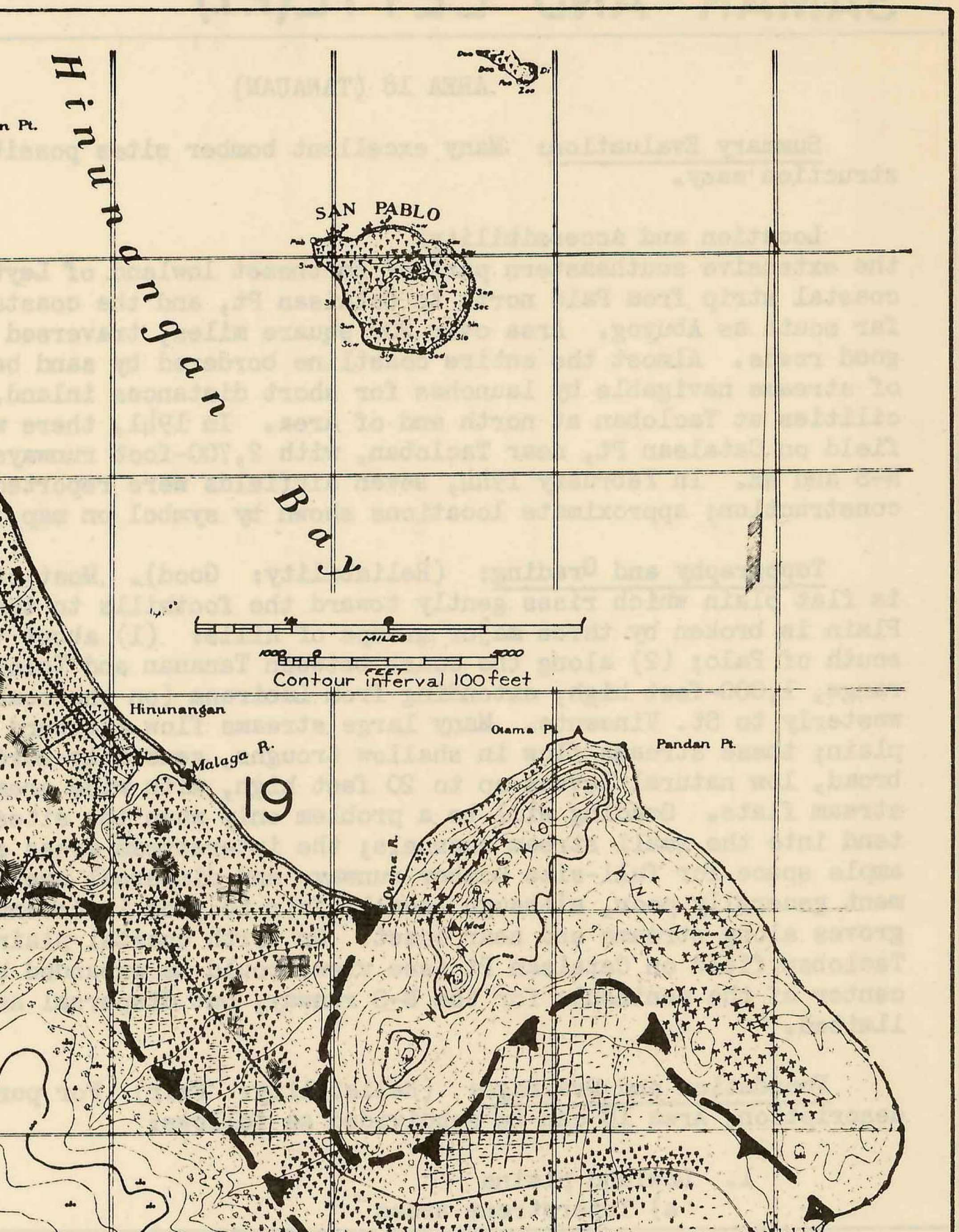
Concealment will be poor.

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The inner flat at Hinunangan
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SAMAR AND LEYTE (P.I.)



Construction Materials (Reliability: Fair) Gravel an
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cellent construction material. Fine sand is available from
No timber in the area.

Clearing: (Reliability: Good) Except for coconut gr
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Water Supply: (Reliability: Good) Abundant water re

AREA 20 (CABALIAN)

Little information available.
See Suggested Airdrome Sites Index
Map and Summary Tabulation of Air-
drome Site Data.

AREA 21 (SAN FRANCISCO

Area not discussed in detail
ible with difficulty; otherwise s
fighter field. Data summarized a

Accessibility: Poor.
Topography: Fair.
Drainage: Good.
Soil: Good.
Water Supply: Good.
Availability of Construction Mat
Ease of Clearing: Fair.

AREA 22 (SOGOD)

Summary Evaluation: Approac
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emergency field. Area not discus

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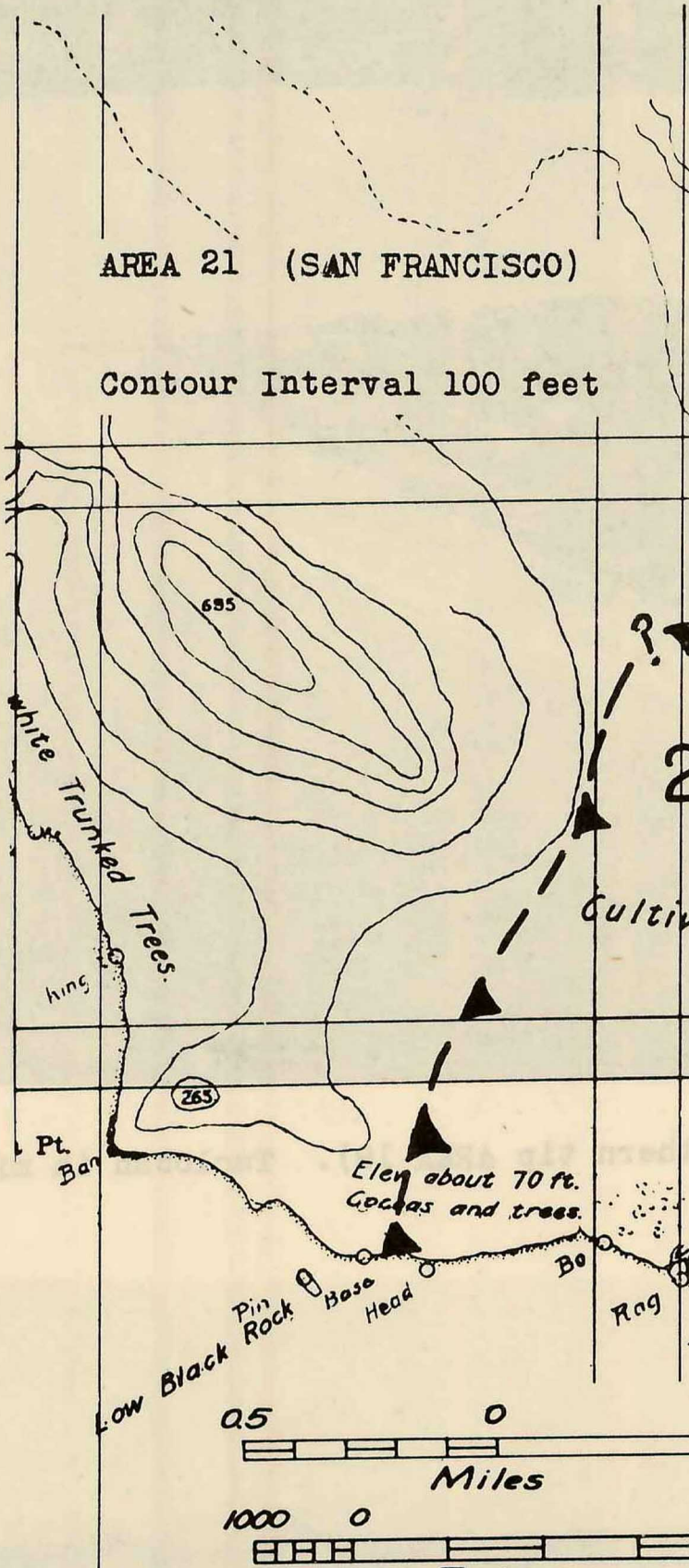
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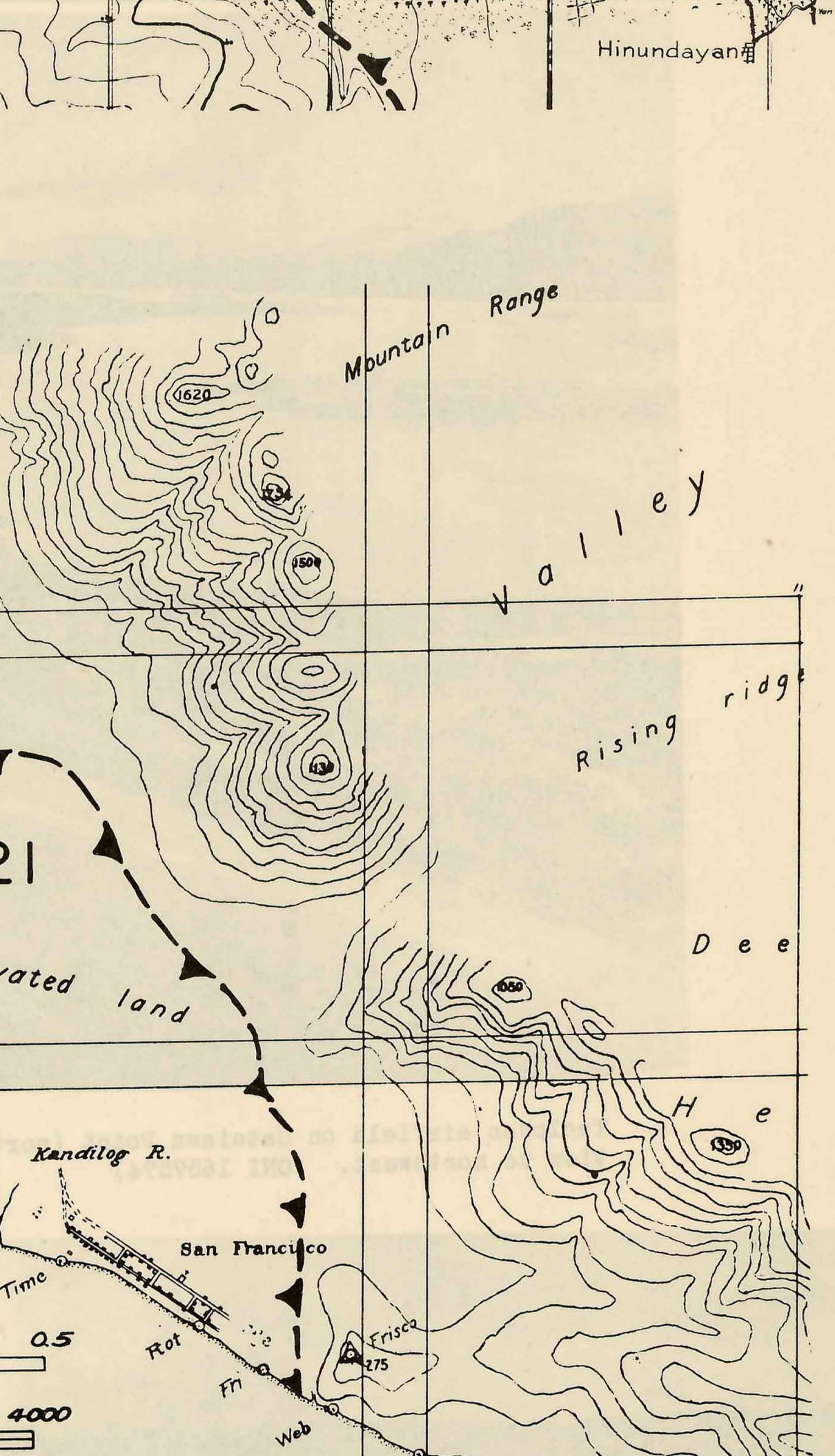
erials: Fair.

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dry-season
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AREA 19 (HINUNANGAN)

Contour Interval 100 feet




Hinundayan
Mountain Range
1620
1500
1050
1350
Valley
Rising ridge
Dee
He
land
Kandilog R.
San Francisco
Frisco
275
Time
0.5
4000
Rot
Fri
Web

Data summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Poor.
Soil: Poor.
Water Supply: Good.
Availability of Construction Mat
Ease of Clearing: Good.

EXPLANATION OF VEGETATION SYMBOLS


Mud flat


Mangrove

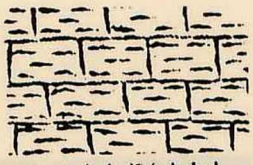

Deciduous trees

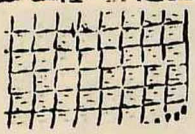

Coconut palms

Hemp

Corn

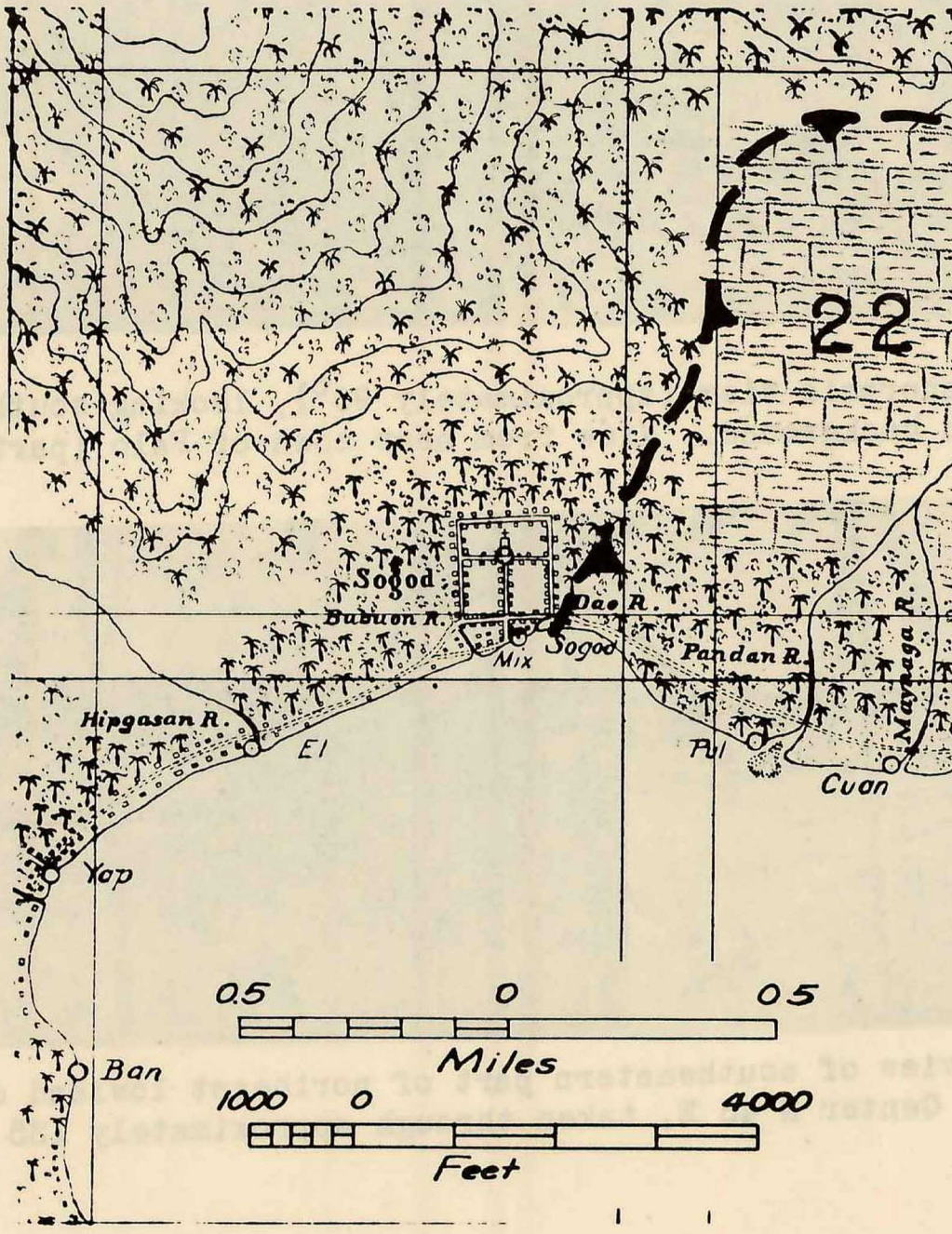

Sugar cane



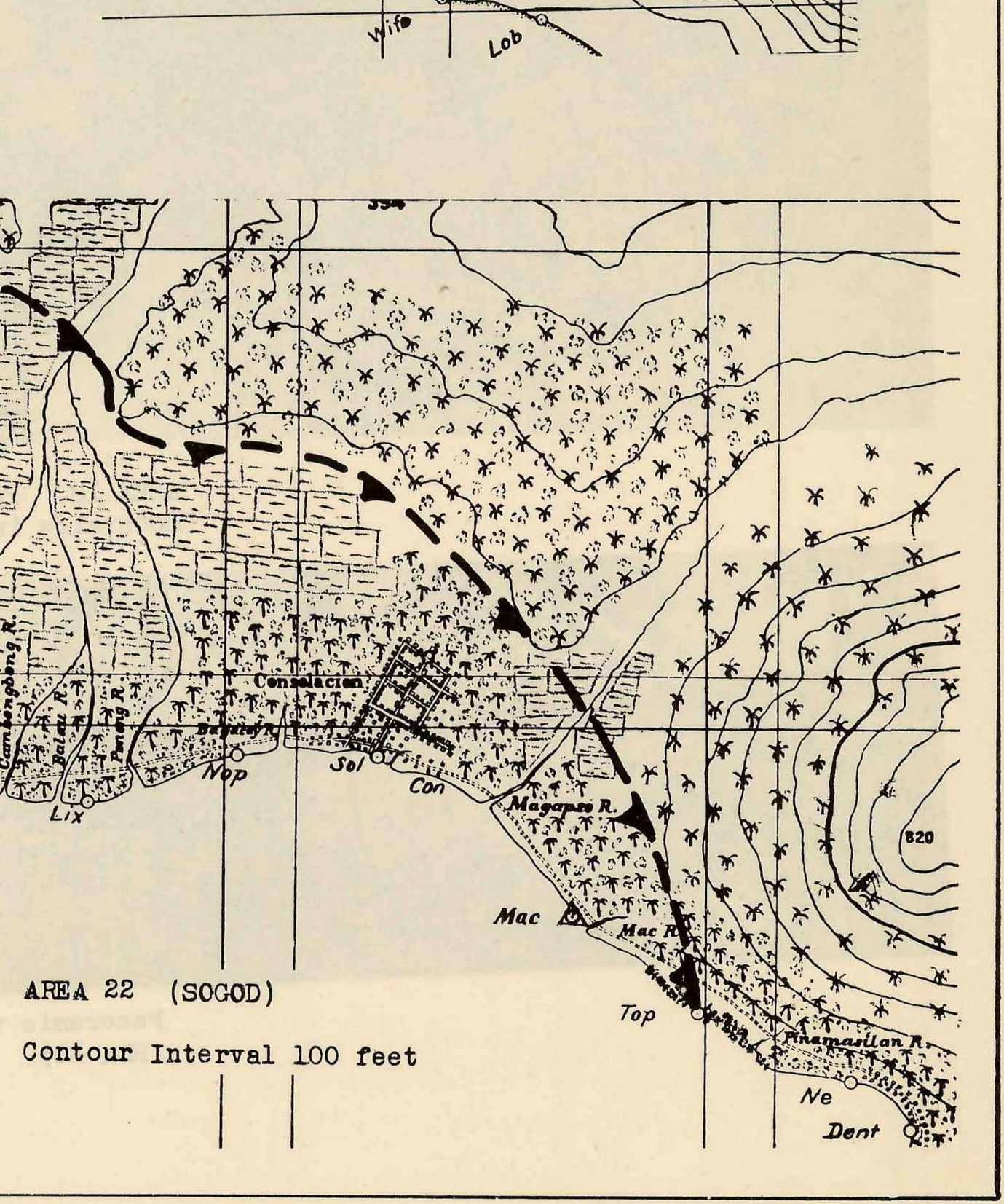

Rice paddies


Cultivated fields

erials: Good.



[redacted]



AREA 22 (SOGOD)

Contour Interval 100 feet

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

AREA 23 (MALITBOG)

Summary Evaluation: Suitable only for single beach strip up to 4,000 feet long. Area not discussed in detail. Data summarized as follows:

Accessibility: Good
Topography: Poor
Drainage: Good.
Soil: Good

Water Supply: Good.
Availability of Construction Materials: Good.
Ease of Clearing: Fair.

AREA 24 (SAN ROQUE)

Summary Evaluation: Probably at least one site suitable for bomber field with clear approaches

Location and Accessibility: On south coast of Leyte Island, near tip of the southwestern peninsula. Area is flat coastal plain, about 4 1/2 by half a mile, extending from Burgos northwestward to Aguinaldo. The coastal road traverses the entire area.

Topography and Grading: (Reliability: Poor) Detailed information not available. Appears to be flat coastal plain, probably underlain by coral limestone now covered with sandy loam. Little grading appears necessary. The area north and east of San Roque would appear to offer good possibilities for a large airfield with runways oriented E-W. Elsewhere runways could be oriented NW. Approach zones would be open.

Foundation and Drainage: (Reliability: Poor). No specific information, but soil is probably sandy or silty loam with good to fair drainage.

Construction Materials: (Reliability: Poor) Most of south coast fringed by coral reefs (bare at low tide) which are the most accessible source of satisfactory construction stone.

Clearing and Grubbing: (Reliability: Fair) Area almost entirely under field cultivation, with scattered stands of coconut palms.

Water Supply: (Reliability: Good) Abundant water available.

AREA 25 (AMPARO)

Summary Evaluation: Approaches poor. Fighter strips can be rapidly constructed. Area not discussed in detail. Data summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Good.
Soil: Good.

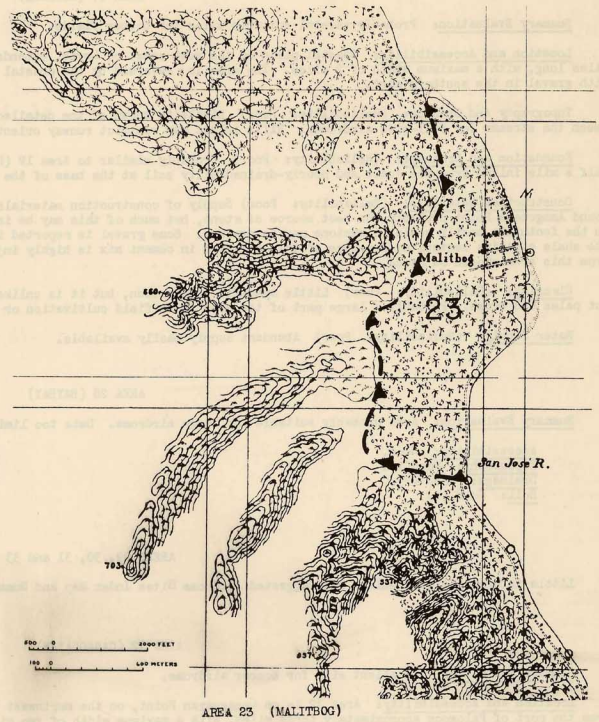
Water Supply: Good.
Availability of Construction Materials: Poor.
Ease of Clearing: Fair.

AREA 26 (MAASIN)

Summary Evaluation: Approaches limited. Fighter strip can be rapidly constructed. Data summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Good.
Soil: Fair.

Water Supply: Good.
Availability of Construction Materials: Poor.
Ease of Clearing: Good.

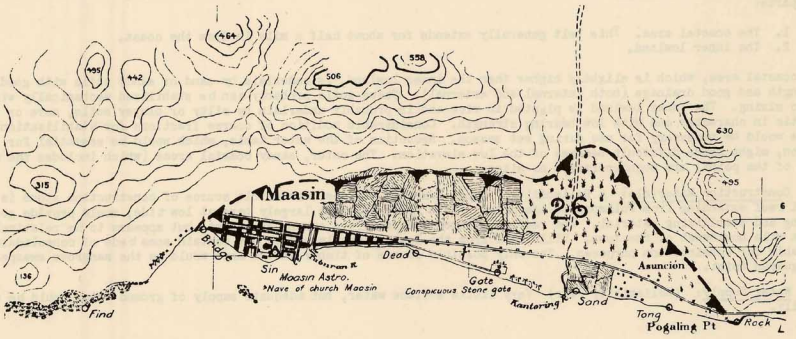


AREA 23 (MALITBOG)

Contour Interval 50 feet

EXPLANATION OF VEGETATION SYMBOLS

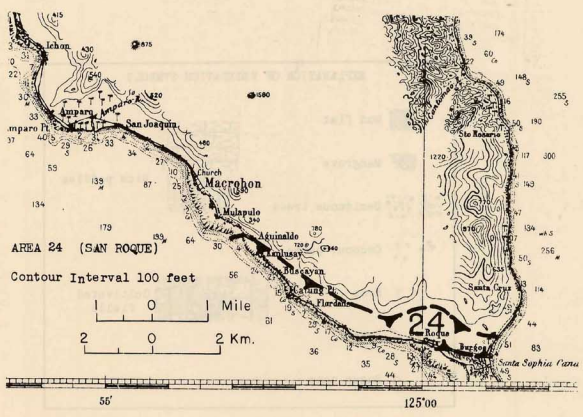
Mud flat
Mangrove
Deciduous trees
Coconut palms
Hemp
Corn
Sugar cane
Rice paddies
Cultivated fields



.5 0 .5
Miles
1000 0 4000
Feet

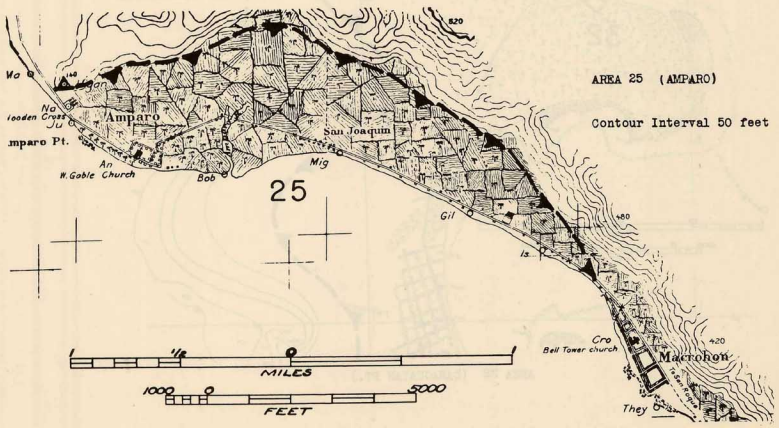
AREA 26 (MAASIN)

Contour Interval 50 feet



AREA 24 (SAN ROQUE)

Contour Interval 100 feet



AREA 25 (AMPARO)

Contour Interval 50 feet

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE(P.I.)

AREA 23 (MALITB

Summary Evaluation: Suitable only for single bea
discussed in detail. Data summarized as follows:

Accessibility: Good
Topography: Poor
Drainage: Good.
Soil: Good

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Ea

AREA 24 (SAN ROQ

Summary Evaluation: Probably at least one site su

Location and Accessibility: On south coast of Ley
insula. Area is flat coastal plain, about 4 1/2 by hal
to Aguinaldo. The coastal road traverses the entire ar

Topography and Grading: (Reliability: Poor) Det
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Little grading appears necessary. The area north and e
possibilities for a large airfield with runways oriente
NW. Approach zones would be open.

Foundation and Drainage: (Reliability: Poor). N
sandy or silty loam with good to fair drainage.

Construction Materials: (Reliability: Poor) Mos
at low tide) which are the most accessible source of sa

Clearing and Grubbing: (Reliability: Fair) Area
scattered stands of coconut palms.

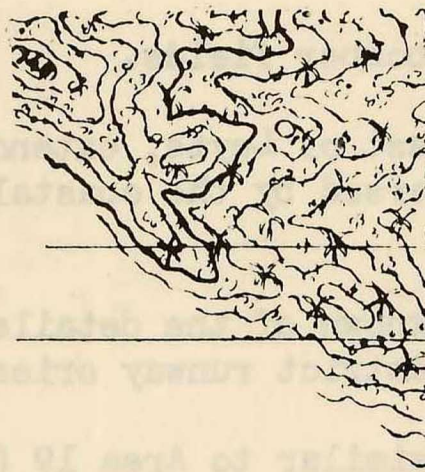
Water Supply: (Reliability: Good) Abundant wate

AREA 25 (AMPARO

OG)

ch strip up to 4,000 feet long. Area not

ter Supply: Good.
ailability of Construction Materials: Good.
se of Clearing: Fair.



UE)

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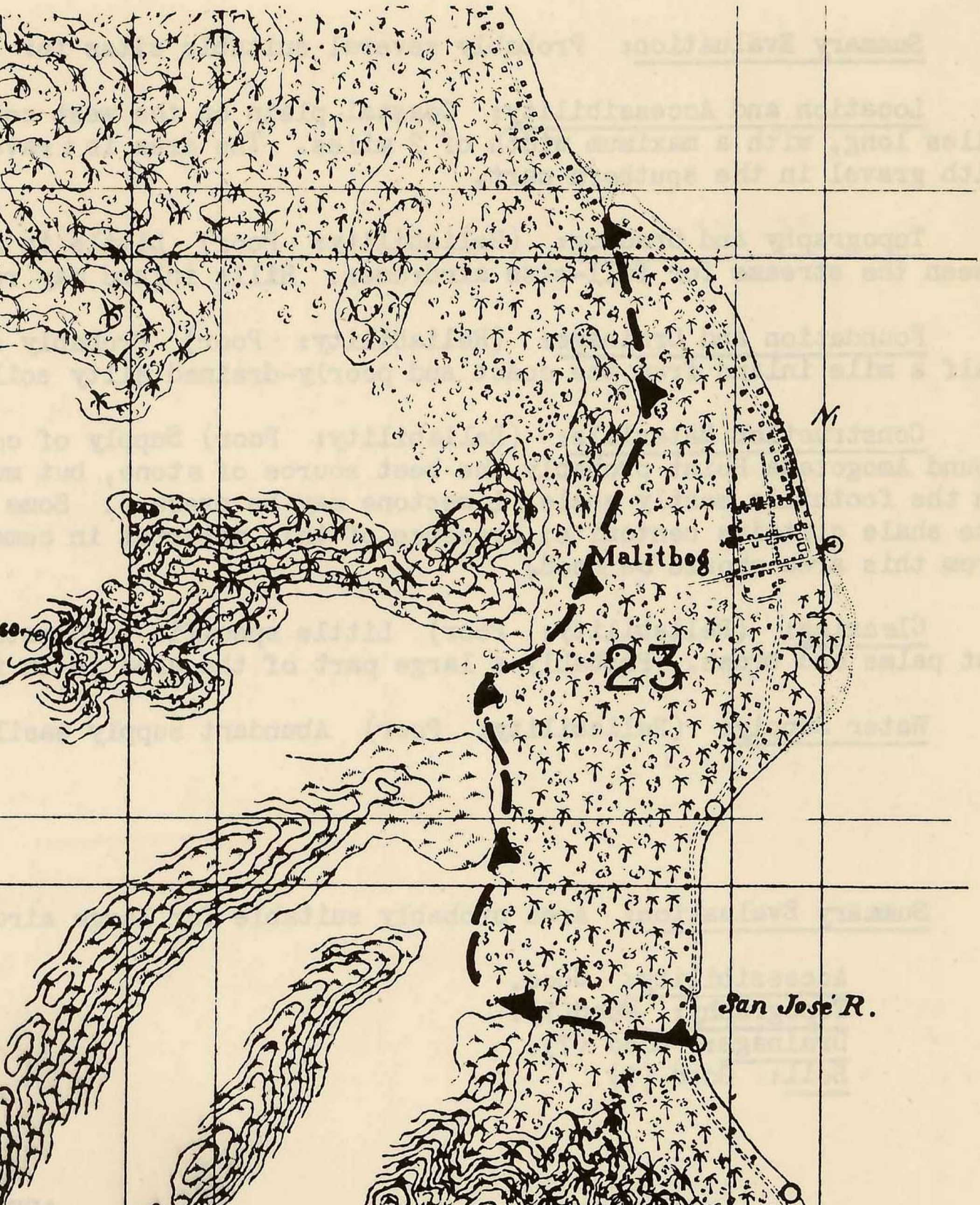
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tisfactory construction stone.

almost entirely under field cultivation, with

r available.

SUGGESTED AIRDROME SITES



Summary Evaluation: Approaches poor. Fighter str
discussed in detail. Data summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Good.
Soil: Good.

W
A
E

AREA 26 (MAASIN

Summary Evaluation: Approaches limited. Fighter
summarized as follows:

Accessibility: Good.
Topography: Poor.
Drainage: Good.
Soil: Fair.

W
A
E

EXPLANATION OF VEGETATION SYMBOLS

Mud flat

Mangrove

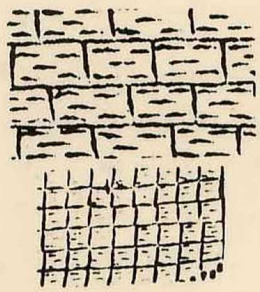
Deciduous trees

Coconut palms

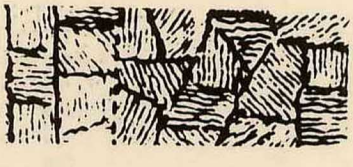
Hemp

Corn

Sugar cane



Rice p



Cultiv
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ips can be rapidly constructed. Area not

ater Supply: Good.
vailability of Construction Materials: Poor.
ase of Clearing: Fair.

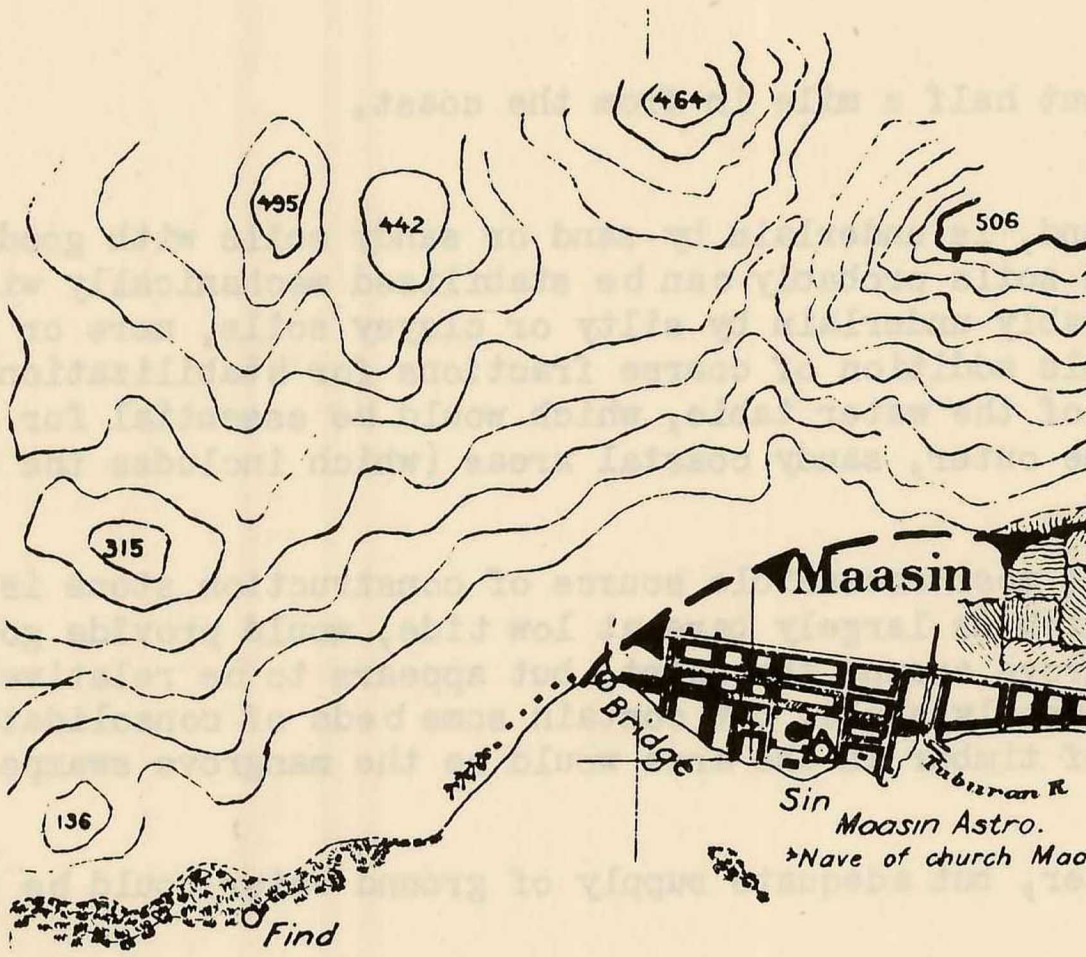
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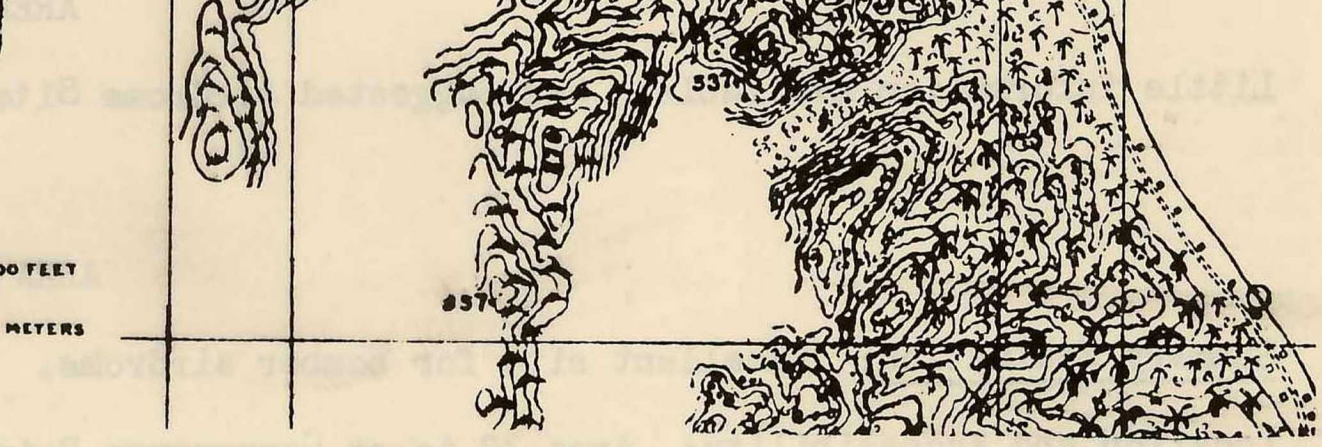
strip can be rapidly constructed. Data

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vailability of Construction Materials: Poor.
ase of Clearing: Good.

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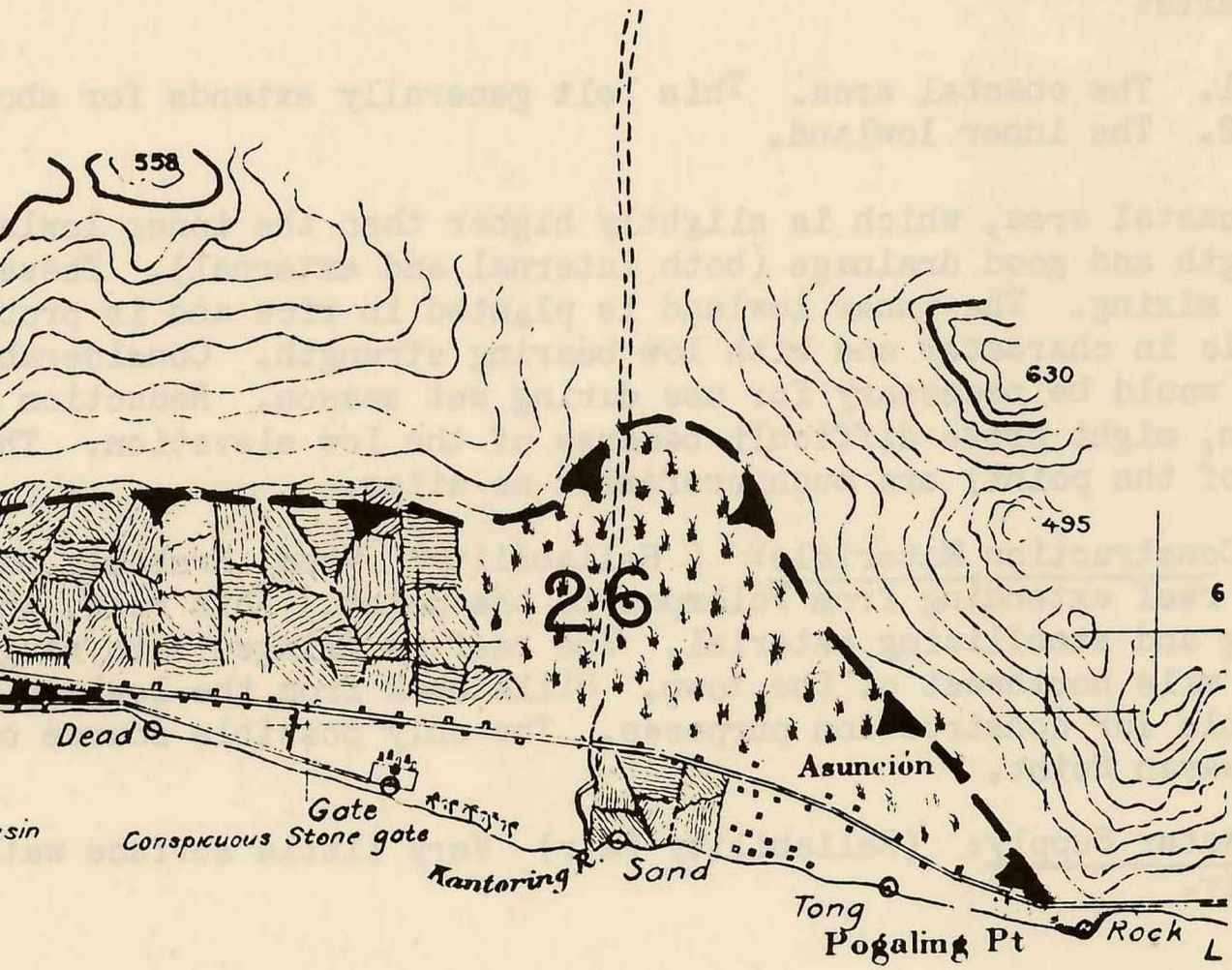
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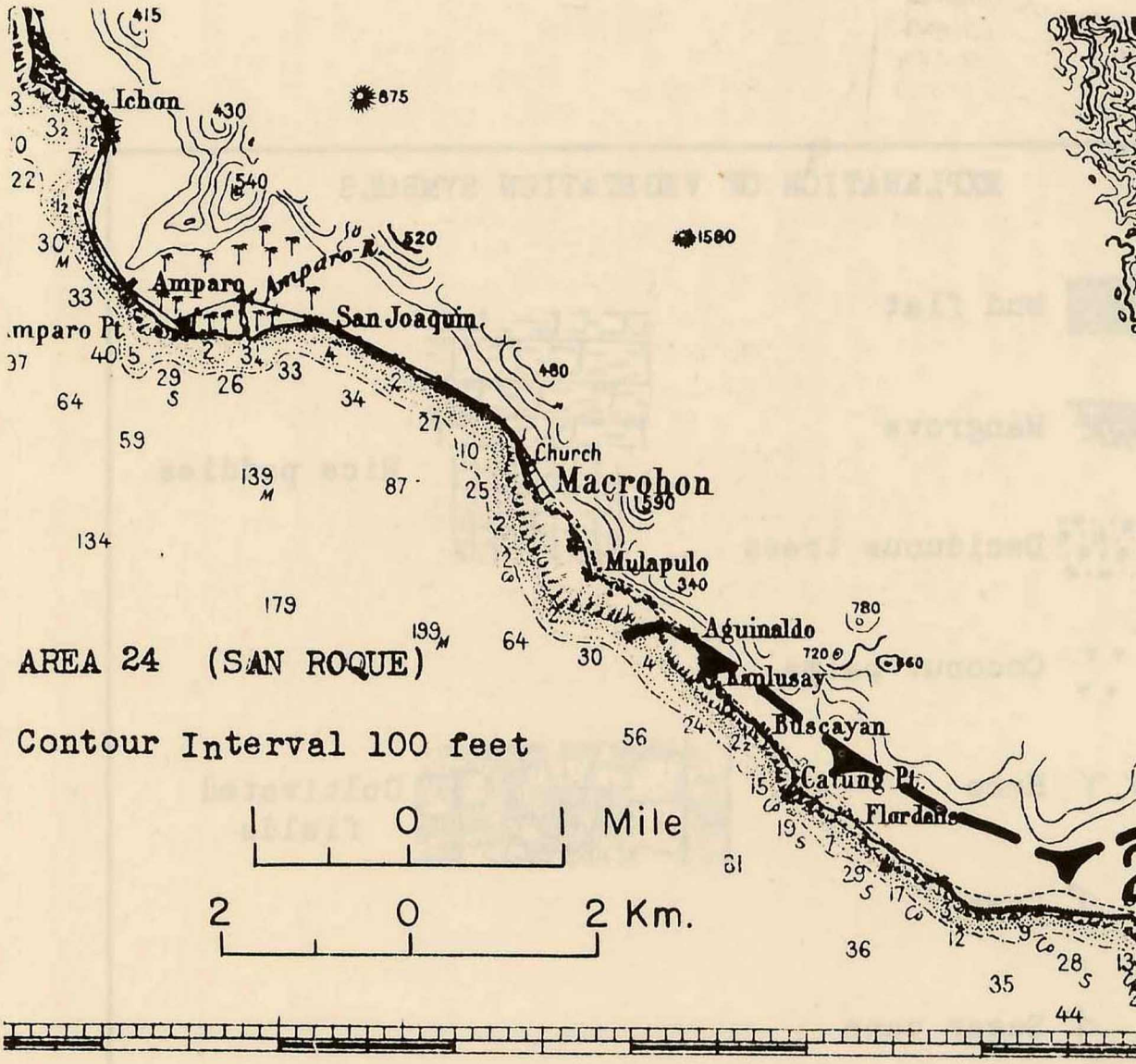


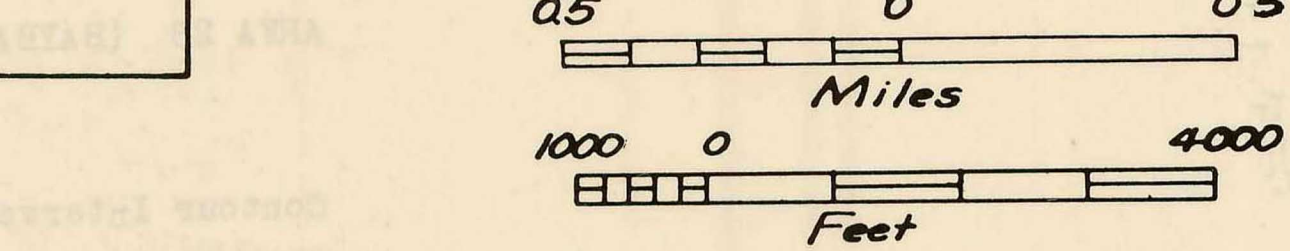


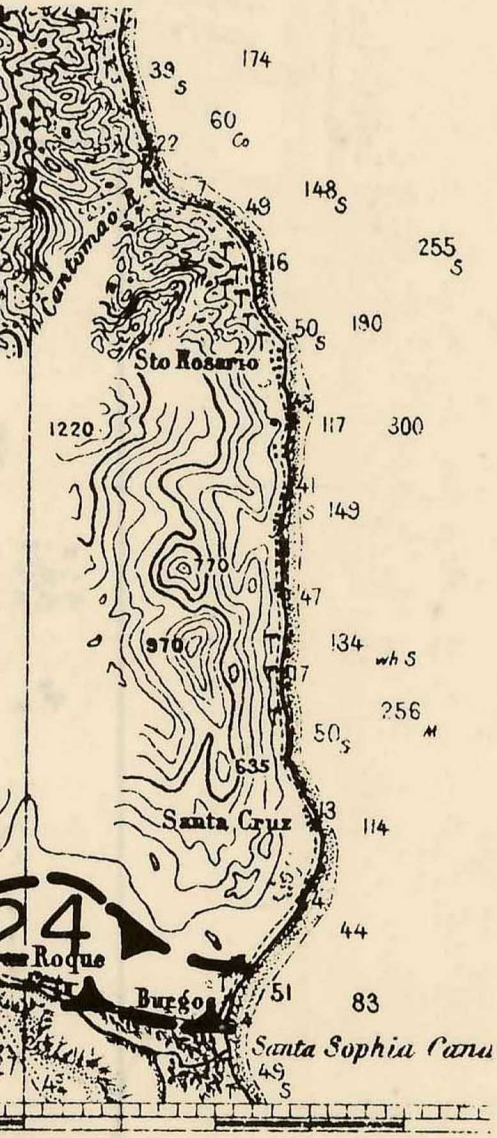
AREA 23 (MALITBOG)

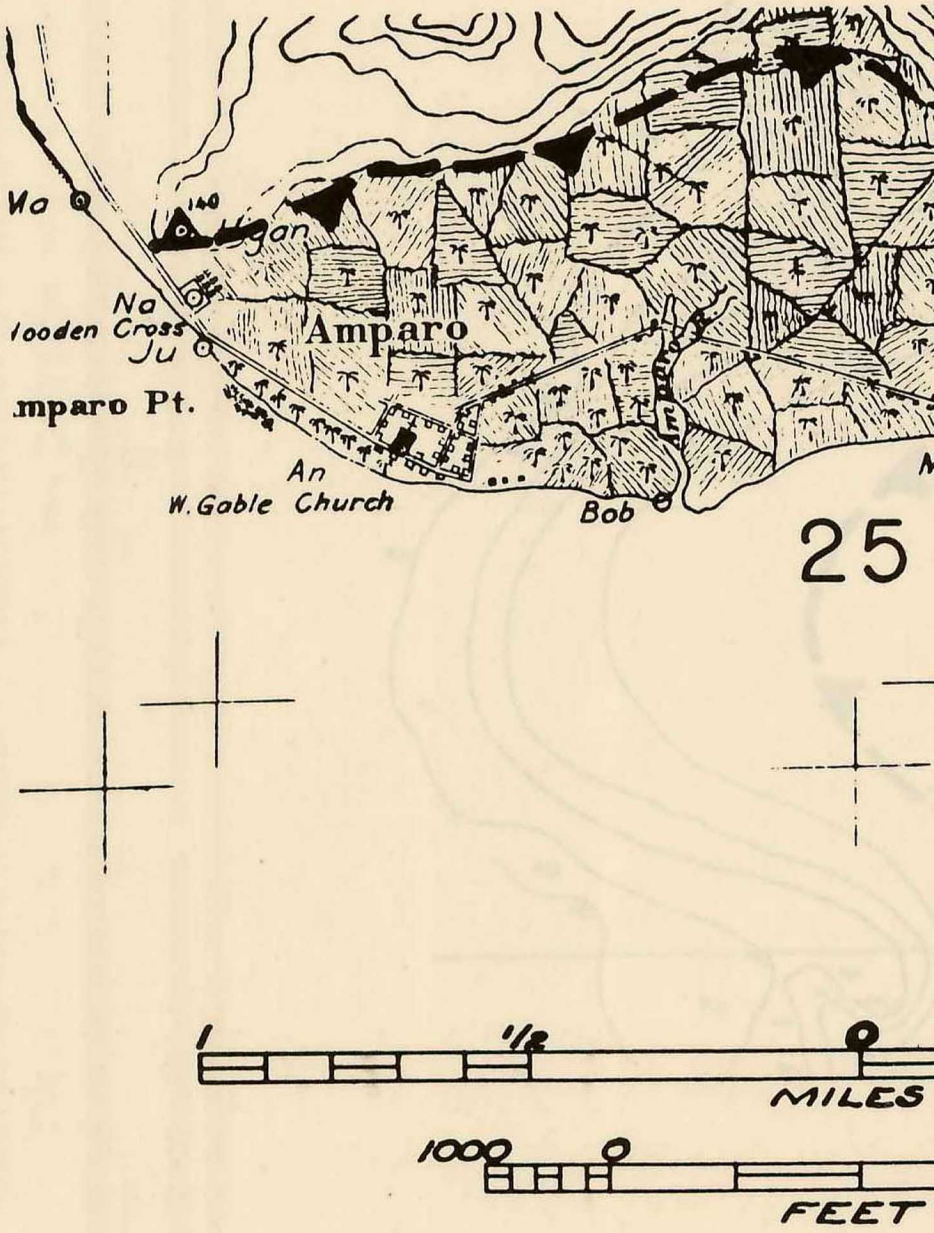
Contour Interval 50 feet




Ichon
Amparo
Amparo R.
San Joaquin
Church
Macrohon
Mulapulo
Aguinaldo
Buscayan
Flordeliz
AREA 24 (SAN ROQUE)
Contour Interval 100 feet
1 0 1 Mile
2 0 2 Km.
55'



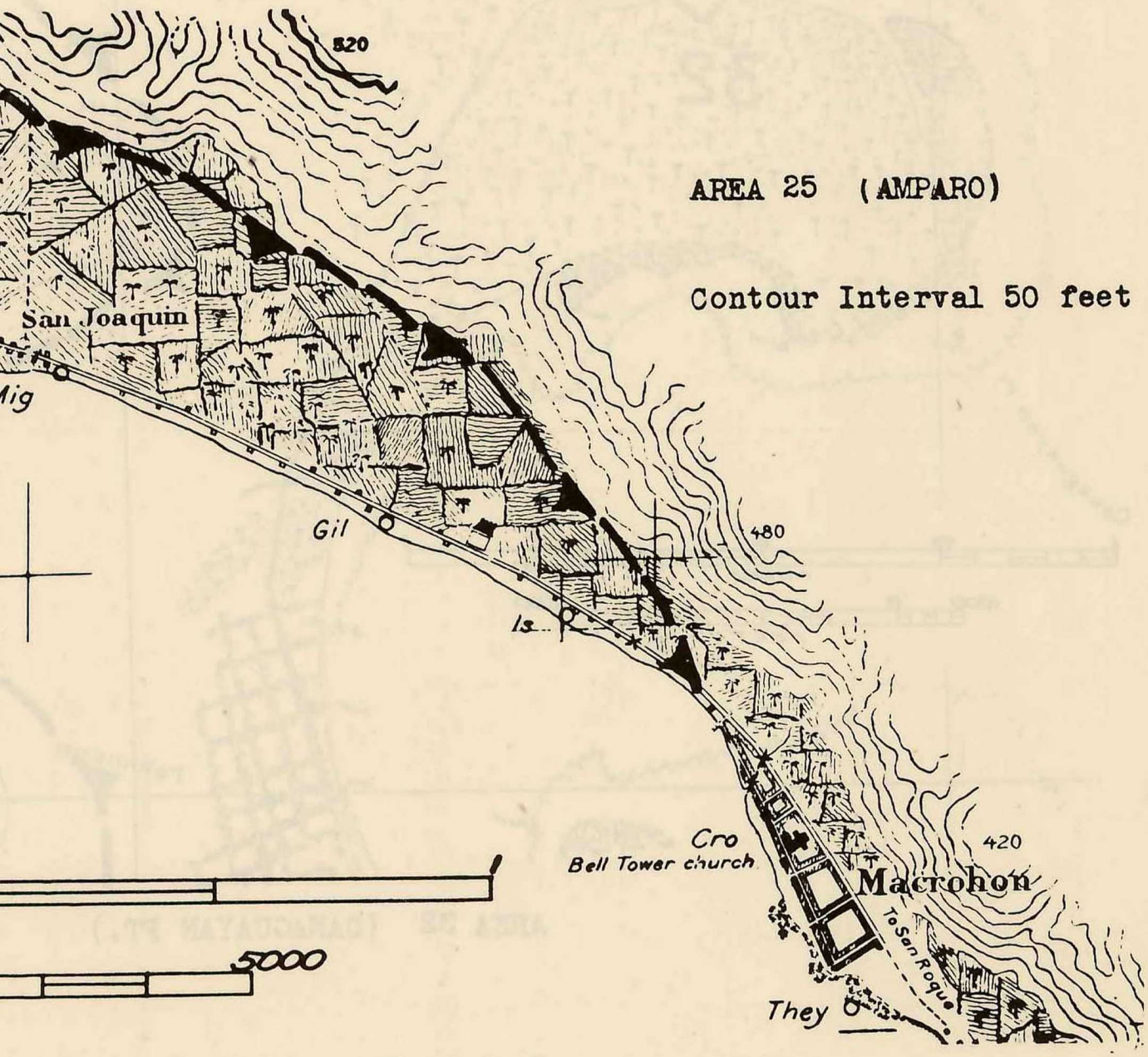




CONFIDENTIAL

AREA 26 (MAASIN)

Contour Interval 50 feet



AREA 25 (AMPARO)

Contour Interval 50 feet

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 27 (HINDANG)

Summary Evaluation: Probably several suitable sites for bomber fields.

Location and Accessibility: Coastal plain on the west coast of Leyte, extends from town of Matalom to Cunalom. Area approximately 20 miles long, with a maximum width of 2 miles. The area is traversed by the coastal highway and most of it is fringed by sand beach (locally with gravel in the southern part.

Topography and Grading: (Reliability: Poor) Little is known of the detailed topography. Area seem to be flat with ample space between the streams for full-size airdromes. Hills inland may restrict runway orientation.

Foundation and Drainage: (Reliability: Poor) Probably similar to Area 19 (Hinanangan), with generally sandy well-drained soil for as half a mile inland from the coast and poorly-drained silty soil at the base of the foothills.

Construction Materials: (Reliability: Poor) Supply of construction materials generally poor. The coral reefs exposed at low tide around Amogotada Point probably the best source of stone, but much of this may be inaccessible because of fringing mangrove swamps. Bedrock in the foothills mostly shale; limestone may be present. Some gravel is reported in stream beds and along southern coast. (Note: Most of the shale contains bentonite; presence of this material in cement mix is highly injurious, so that no bedrock or gravel containing shale from this area should be used.)

Clearing: (Reliability: Poor) Little specific information, but it is unlikely that there will be anything more difficult than coconut palms and brush. Probably a large part of the area is in field cultivation or in grass.

Water Supply: (Reliability: Poor) Abundant supply easily available.

AREA 28 (BAYBAY)

Summary Evaluation: Area probably suitable for large airdrome. Data too limited for detailed discussion; summarized as follows:

Accessibility: Good.
Topography: Good(?).
Drainage: Good (?).
Soil: Good (?).
Water Supply: Good.
Availability of Construction Materials: Fair.
Ease of Clearing: Fair.

AREAS 29, 30, 31 and 33

Little information available. See Suggested Airdrome Sites Index Map and Summary Tabulation of Airdrome Site Data.

AREA 32 (CANAGUAYAN)

Summary Evaluation: Excellent site for bomber airdrome.

Location and Accessibility: Area 32 is on Canaguayan Point, on the northwest peninsula of Leyte. It extends northerly from the port of Palompon approximately three miles, with a maximum width of two miles. Polompon, which has wharf facilities, is the west end of the interior highway from the north Leyte coast. The south side of the point is fringed with a coral reef about a quarter of a mile wide fringed with mangrove swamp, but the north side is believed to be sandy beach.

Topography and Grading: (Reliability: Good) The topography of the area is excellent. There is space for 6,000-foot runways oriented NE and NNW with clear approaches and adequate area for dispersal and hardstands. From the coast the land is believed to rise very gently to the crest of a broad, low swell varying from a quarter to half a mile in width which is separated from the foothills by a slightly lower, poorly-drained area. Grading will be very light. Cover and concealment are probably fair to good in coves of lowland which extend into the foothill belt.

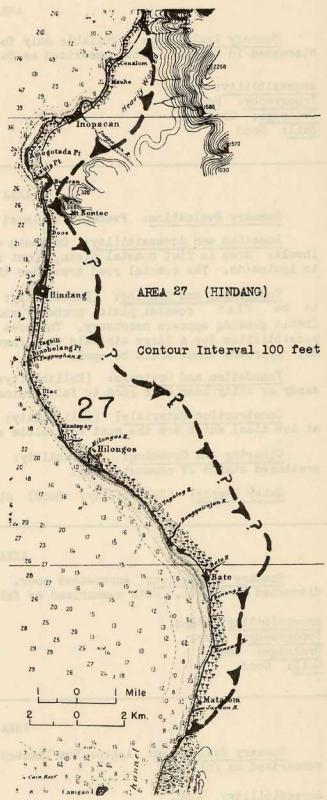
Foundation and Drainage: (Reliability: Fair) For discussion of foundation and drainage, the area can be divided into two parts:

1. The coastal area. This belt generally extends for about half a mile in from the coast.
2. The inner lowland.

The coastal area, which is slightly higher than the inner lowland, is underlain by sand or sandy soils with good bearing strength and good drainage (both internal and external). These soils probably can be stabilized mechanically with little or no mixing. The inner lowland is planted in rice and is probably underlain by silty or clayey soils, more or less plastic in character and with low bearing strength. Considerable addition of coarse fractions for stabilization as subgrade would be necessary for use during wet season. Reduction of the water table, which would be essential for stabilization, might prove difficult because of the low elevation. The outer, sandy coastal areas (which includes the major part of the point) are much preferred as sites.

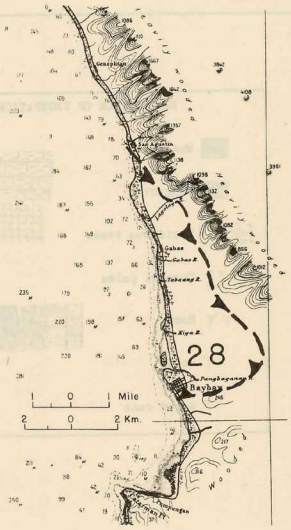
Construction Materials: (Reliability: Good) Probably the most accessible source of construction stone is the coral reef extending from Polompon to the point. This reef, which is largely bare at low tide, would provide good surfacing and stabilizing material. The reef is fringed with mangrove around the point, but appears to be relatively accessible for a mile northwest of the town. Hills back from the lowland mostly shale, but contain some beds of consolidated limestone suitable for construction purposes. The only possible source of timber in the area would be the mangrove swamps that fringe Canaguayan Point.

Water Supply: (Reliability Fair) Very little surface water, but adequate supply of ground water could be developed readily.



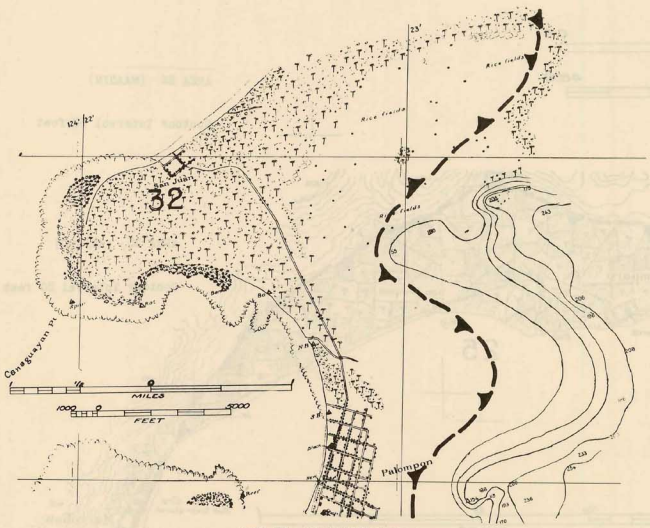
AREA 27 (HINDANG)

Contour Interval 100 feet



AREA 28 (BAYBAY)

Contour Interval 100 feet



AREA 32 (CANAGUAYAN PT.)

Contour Interval 50 feet

EXPLANATION OF VEGETATION SYMBOLS

- Mud flat
- Mangrove
- Deciduous trees
- Coconut palms
- Hemp
- Corn
- Sugar cane
- Rice paddies
- Cultivated fields

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

SUGGESTED AIRDROME SITES

Summary Evaluation: Probably several suitable sites f

Location and Accessibility: Coastal plain on the west
miles long, with a maximum width of 2 miles. The area is t
with gravel in the southern part.

Topography and Grading: (Reliability: Poor) Little
tween the streams for full-size airdromes. Hills inland ma

Foundation and Drainage: (Reliability: Poor) Probab
half a mile inland from the coast and poorly-drained silty

Construction Materials: (Reliability: Poor) Supply o
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in the foothills mostly shale; limestone may be present. S
the shale contains bentonite; presence of this material in
from this area should be used.)

Clearing: (Reliability: Poor) Little specific infor
nut palms and brush. Probably a large part of the area is

Water Supply: (Reliability: Poor) Abundant supply e

Summary Evaluation: Area probably suitable for large

Accessibility: Good.
Topography: Good(?).
Drainage: Good (?).
Soil: Good (?).

[redacted]

AREA 27 (HINDANG)

or bomber fields.

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raversed by the coastal highway and most of it is fringed by sand beach (

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cement mix is highly injurious, so that no bedrock or gravel containing

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in field cultivation or in grass.

asily available.

AREA 28 (BAYBAY)

airdrome. Data too limited for detailed discussion; summarized as follo

Water Supply: Good.
Availability of Construction Materials: Fair.
Ease of Clearing: Fair.

SAMAR AND LEYTE (P.I.)

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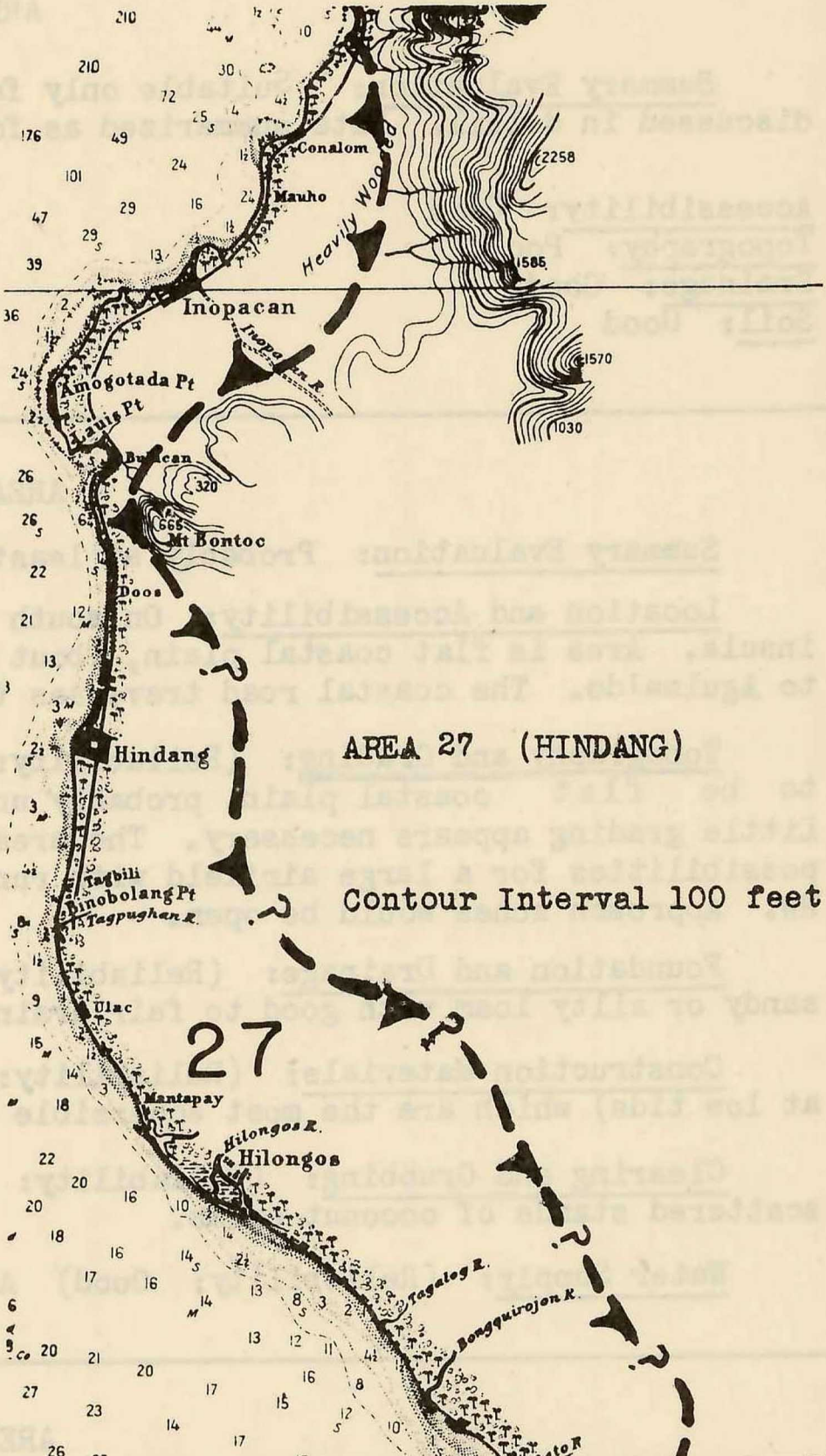
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Little information available. See Suggested Airdrome

A

Summary Evaluation: Excellent site for bomber airdrom

Location and Accessibility: Area 32 is on Canaguayan
from the port of Palompon approximately three miles, with a
is the west end of the interior highway from the north Leyt
reef about a quarter of a mile wide fringed with mangrove s

Topography and Grading: (Reliability: Good) The top
runways oriented NE and NNW with clear approaches and adequ
is believed to rise very gently to the crest of a broad, lo
separated from the foothills by a slightly lower, poorly-dr
are probably fair to good in coves of lowland which extend

Foundation and Drainage: (Reliability: Fair) For di
two parts:

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2. The inner lowland.

The coastal area, which is slightly higher than the inner l
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grade would be necessary for use during wet season. Reduct
zation, might prove difficult because of the low elevation.
part of the point) are much preferred as sites.

Construction Materials: (Reliability: Good) Probabl
coral reef extending from Polompon to the point. This reef
facing and stabilizing material. The reef is fringed with
for a mile northwest of the town. Hills back from the lowl
suitable for construction purposes. The only possible sour
Canaguayan Point.

Water Supply: (Reliability Fair) Very little surface
readily.

AREAS 29, 30, 31 and 33

Sites Index Map and Summary Tabulation of Airdrome Site Data.

REA 32 (CANAGUAYAN)

ie.

Point, on the northwest peninsula of Leyte. It extends northerly
maximum width of two miles. Polompon, which has wharf facilities,
e coast. The south side of the point is fringed with a coral
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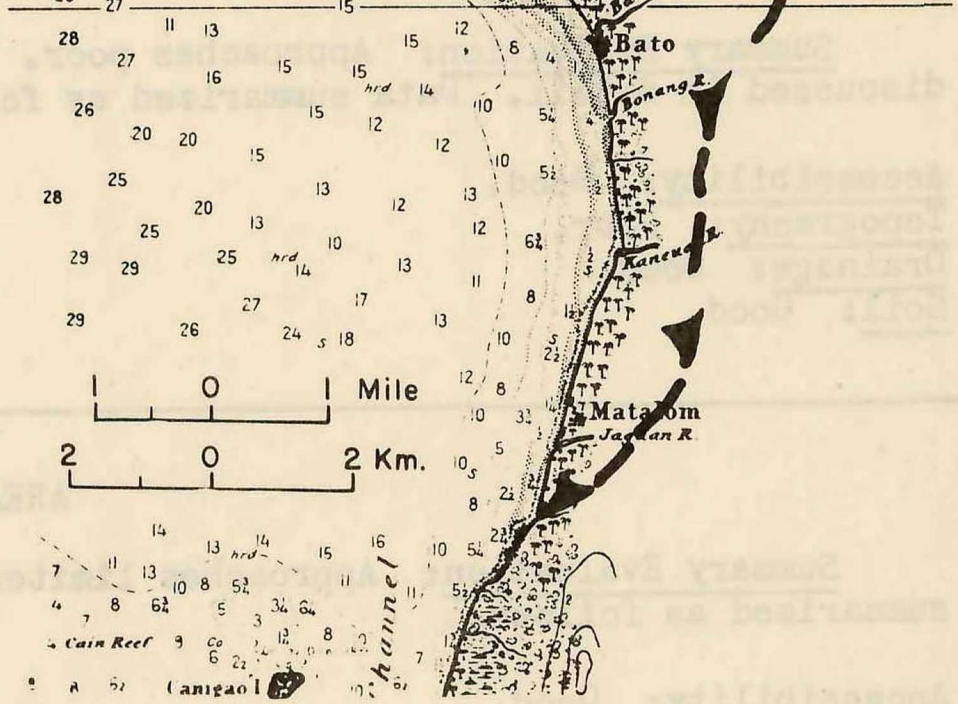
scussion of foundation and drainage, the area can be divided into

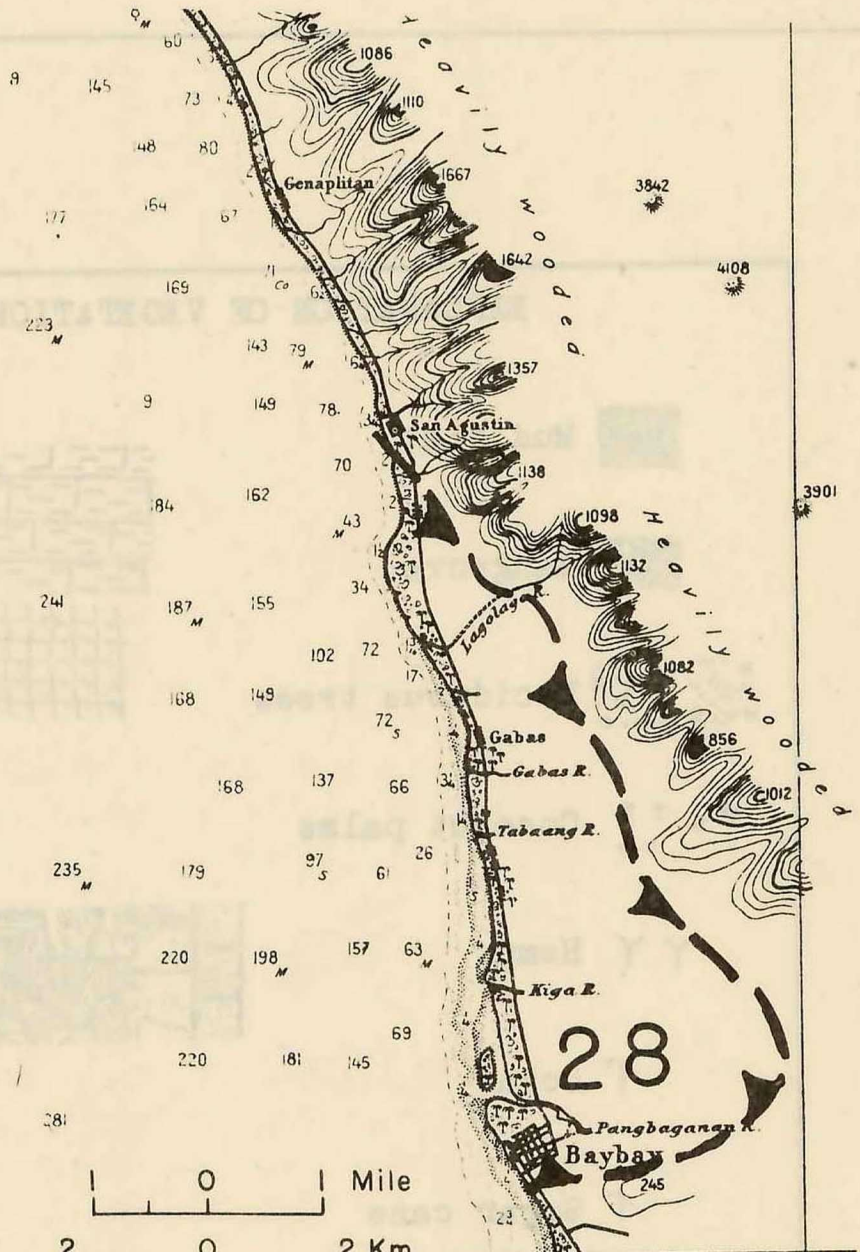
about half a mile in from the coast.

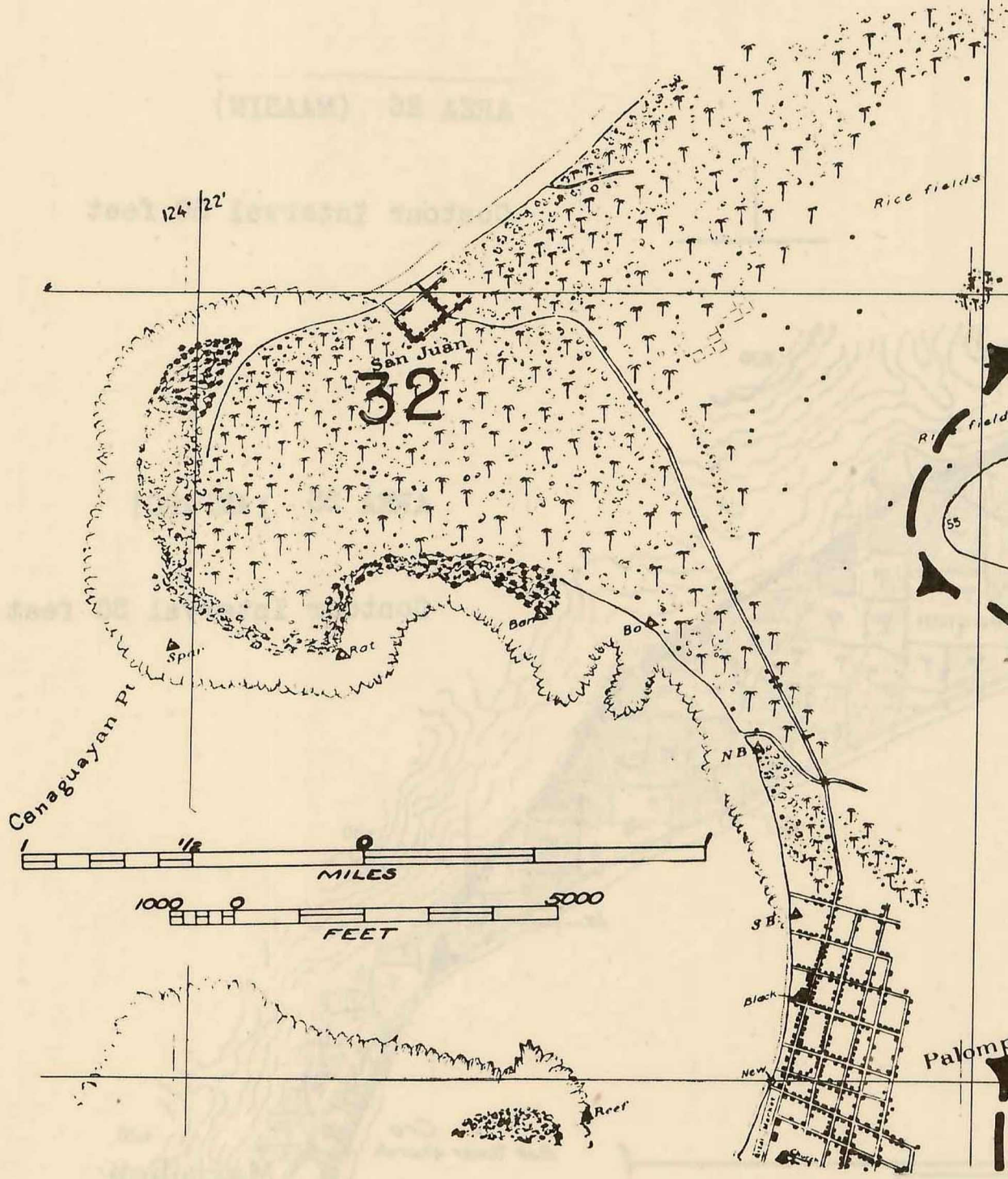
owland, is underlain by sand or sandy soils with good bearing
These soils probably can be stabilized mechanically with little
probably underlain by silty or clayey soils, more or less
derable addition of coarse fractions for stabilization as sub-
tion of the water table, which would be essential for stabili-
. The outer, sandy coastal areas (which includes the major

ly the most accessible source of construction stone is the
f, which is largely bare at low tide, would provide good sur-
mangrove around the point, but appears to be relatively accessible
land mostly shale, but contain some beds of consolidated limestone
rce of timber in the area would be the mangrove swamps that fringe

e water, but adequate supply of ground water could be developed


Bato
Bonang R.
Kaneuk R.
Matalom
Jaodan R.
Cain Reef
Canigao I.
Channel
1 0 1 Mile
2 0 2 Km.


Genaplitan
San Agustin
Lagolagon R.
Gabas
Gabas R.
Tabaang R.
Kiga R.
Pangbaganan R.
Baybay
28
Heavily wooded
1086
1110
1667
3842
1642
4108
1357
1138
3901
1098
1132
1082
856
1012
245
1 0 1 Mile
2 0 2 Km.

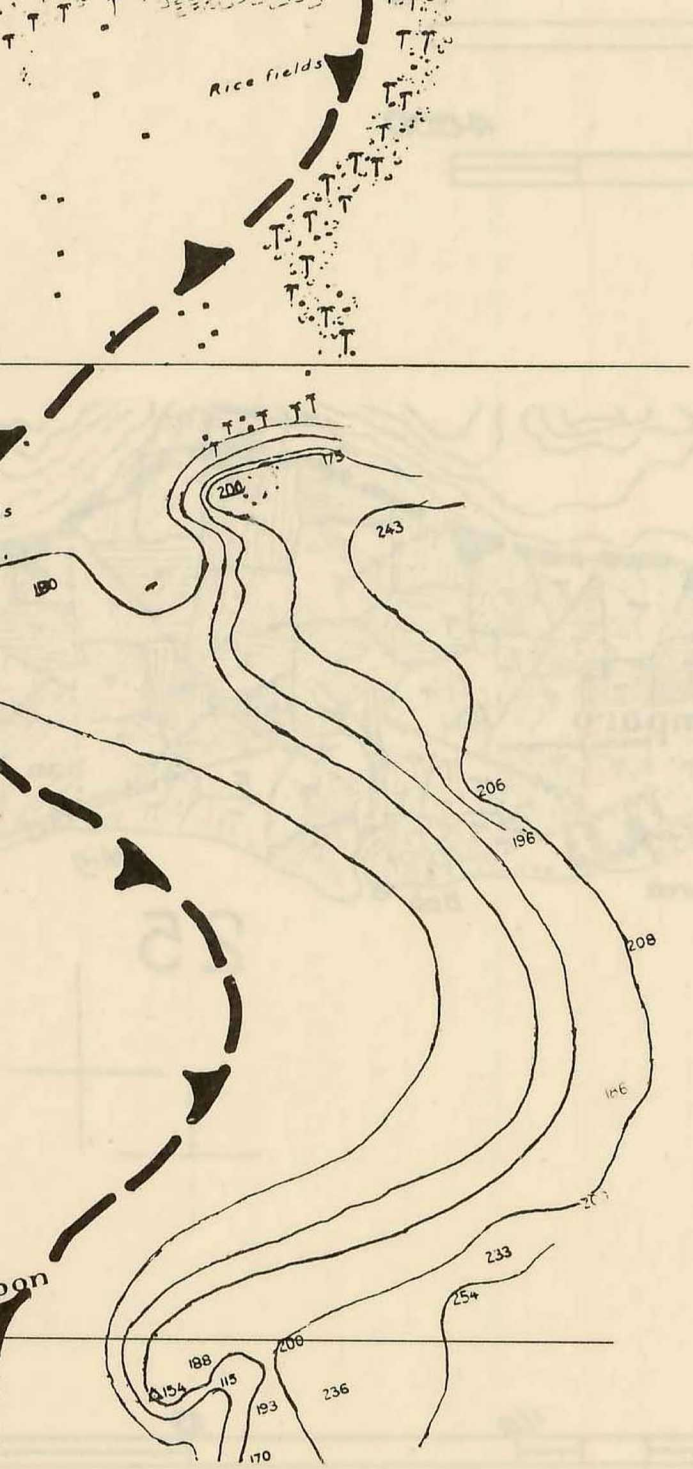


AREA 32 (CANAGUAYAN PT.

Contour Interval 50 feet

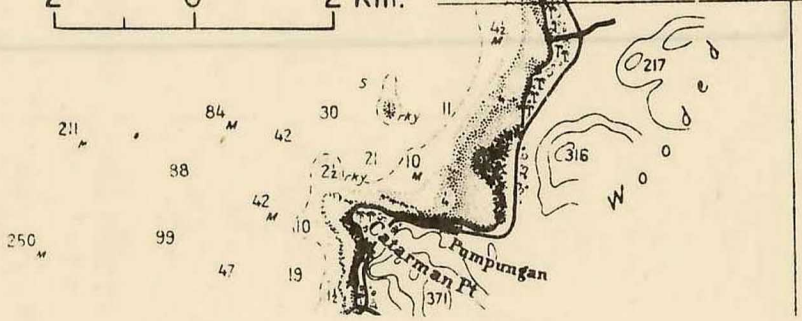
AREA 28 (BA

Contour Inte



AYBAY)

erval 100 feet



EXPLANATION OF VEGETATION SYMBOLS

Mud flat

Mangrove

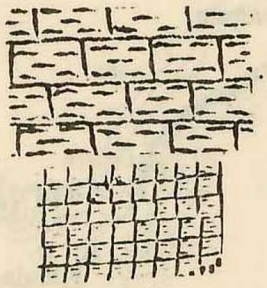
Deciduous trees

Coconut palms

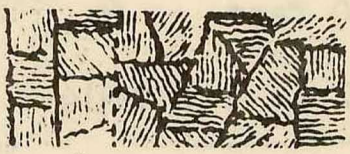
Hemp

Corn

Sugar cane



Rice paddies



Cultivated fields

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

AREA 34 (CARIGARA)

Summary Evaluation: Many good sites for bomber airdromes; rapid construction possible.

Location and Accessibility: Area 34 includes the northwestern part of the northeast lowland of Leyte, and the coastal plain as far northeast as Jalaba Point and as far southwest as the town of Capocan. The total area is about 5 by 10 miles. The area is traversed by good roads. A shallow sand beach extends along the entire coastline. Port facilities (probably very limited) at Carigara, the main town.

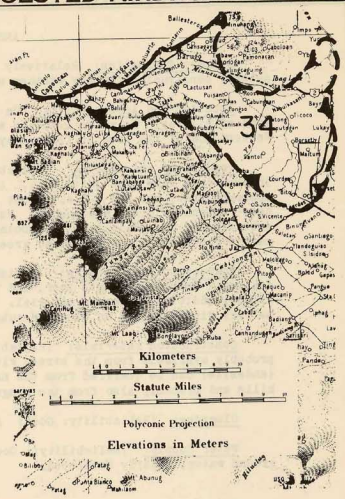
Topography and Grading: (Reliability: Good) Extensive areas of flat plain, crossed by many large streams flowing in shallow troughs. Grading very light. Topographic hazards few. Concealment poor.

Foundation and Drainage: (Reliability: Fair.) Varies from poor to good. The extensive interstream flats have silt or clay loam soil with poor to fair drainage; generally requiring subdrains and addition of coarse fraction for subgrade stabilization. Soils near streams and on outer part of coastal plains more sandy, better drained, with good bearing strength. See Area 18 for more complete discussion of similar area.

Construction Materials: (Reliability: Fair.) Probably most of the streams have gravelly or sandy beds. Gravel is reported at or near the villages of Bahiguhay and Canomantag (southeast and east of Carigara). Some sand might be available from coastal beaches but most of it is probably too fine-grained. Coral reefs, exposed at low tide along the coast from the town of Capocan to Culasian Point would be good sources of construction rock but may be somewhat inaccessible because of mangrove swamps. No timber available in the area, except possibly from the mangrove swamps east of Capocan.

Clearing and Grubbing: (Reliability: Good.) Area mainly under cultivation, with some coconut palm and grassland.

Water Supply: (Reliability: Good.) Excellent supply from numerous perennial streams. Ground water abundant; easily developed.



AREA 34 (CARIGARA)

AREA 35 (BOHOL)

Summary Evaluation: Suitable for single runway bomber field; clear approaches. Rapid construction possible.

Location and Accessibility: On the northeast coast of Biliran Island, between the towns of Bohol and Culuba. Area approximately 2 1/2 miles long by about one mile maximum width. No roads into area. Sandy beach.

Topography and Grading: (Reliability: Good) Ample space for 6,000-foot runways, but the only orientation giving clear approaches at both ends is NW. Diversion of several small streams would be necessary, but grading would be generally light.

Foundation and Drainage: (Reliability: Fair) The area is probably underlain by silty soil, with fair drainage and fair bearing strength. It probably can be drained without much difficulty, but subgrade stabilization would require addition of coarse material.

Construction Materials: (Reliability: Fair) Abundant gravel probably in and near streams within less than a mile from coast. Excellent timber in foothills.

Clearing and Grubbing: (Reliability: Good) Almost negligible.

Water Supply: (Reliability: Good) Good supply from perennial streams. Ground water abundant; readily developed.



AREA 34. View of Carigara and northwestern part of the northeast lowland of Leyte. View to southeast. (ONI 62004)

AREA 36 (CAIBIRAN)

Summary Evaluation: Area suitable for bomber or fighter field with one way approach only. Rapid construction possible.

Location and Accessibility: Deltaic flat on the east coast of Biliran Island, near the town of Caibiran. No roads into this area. Sandy beach.

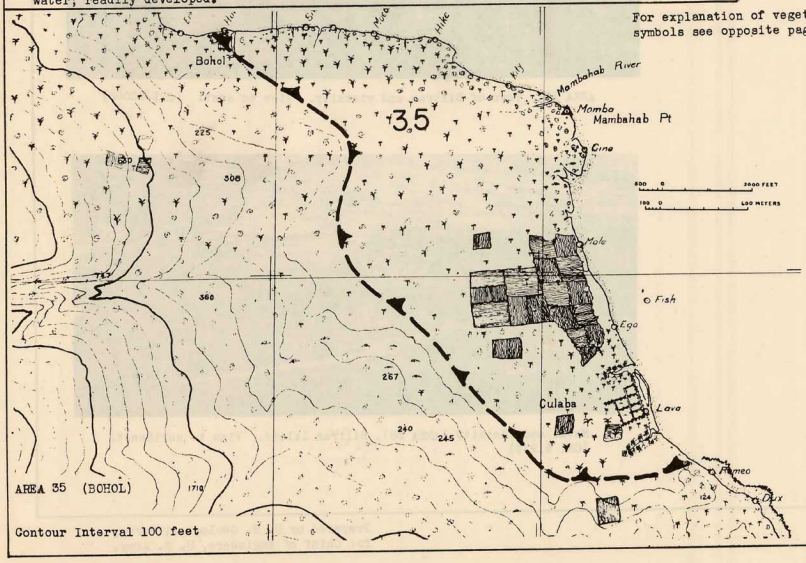
Topography and Grading: (Reliability: Good) Ample space is available for large runways, but approaches open only from east and north. Diversion of small streams necessary but otherwise grading light.

Foundation and Drainage: (Reliability: Fair) Soil will be silty to clay loam, sandy near the streams. Bearing strength poor to fair; drainage fair.

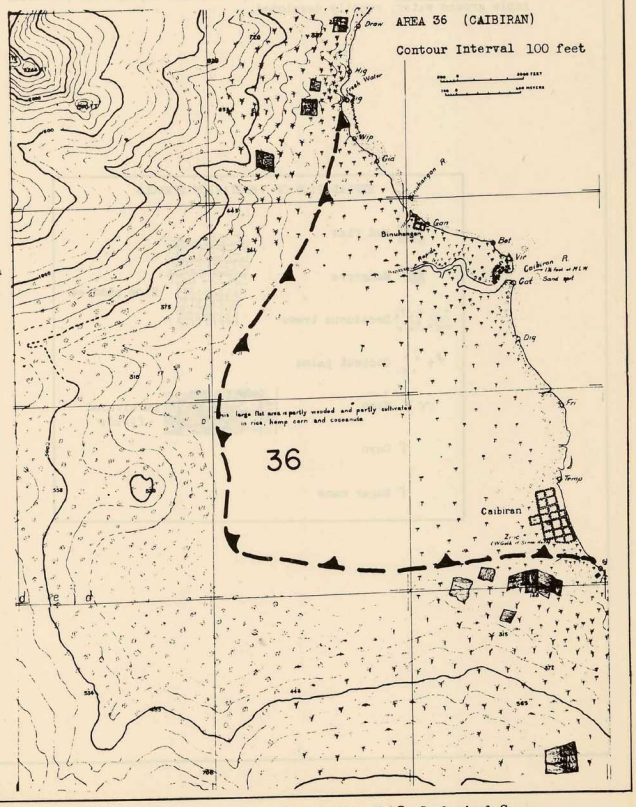
Construction Materials: (Reliability: Fair) Abundant gravel probably in and near streams within less than a mile from coast. Good timber in foothills.

Clearing and Grubbing: (Reliability: Good) Almost negligible.

Water Supply: (Reliability: Good) Good supply from perennial streams. Abundant ground water; readily developed.



For explanation of vegetation symbols see opposite page.



Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

Summary Evaluation: Many good sites for bomber ai

Location and Accessibility: Area 34 includes the
northeast as Jalaba Point and as far southwest as the to
roads. A shallow sand beach extends along the entire co

Topography and Grading: (Reliability: Good) Exter
Grading very light. Topographic hazards few. Concealme

Foundation and Drainage: (Reliability: Fair.) Var
with poor to fair drainage; generally requiring subdrain
on outer part of coastal plains more sandy, better drain
area.

Construction Materials: (Reliability: Fair.) Prob
the villages of Bahiguhay and Canomantag (southeast and
is probably too fine-grained. Coral reefs, exposed at l
sources of construction rock but may be somewhat inacces
from the mangrove swamps east of Capocan.

Clearing and Grubbing: (Reliability: Good.) Area

Water Supply: (Reliability: Good.) Excellent su

AREA 35 (BOHOL)

Summary Evaluation: Suitable for single runway b

AREA 34 (CARIGARA)

rdromes; rapid construction possible.

northwestern part of the northeast lowland of Leyte, and the coastal plain
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ent poor.

ries from poor to good. The extensive interstream flats have silt or clay
ns and addition of coarse fraction for subgrade stabilization. Soils near
ned, with good bearing strength. See Area 18 for more complete discussion

bably most of the streams have gravelly or sandy beds. Gravel is reported
east of Carigara). Some sand might be available from coastal beaches but
low tide along the coast from the town of Capocan to Culasian Point would b
ssible because of mangrove swamps. No timber available in the area, except

mainly under cultivation, with some coconut palm and grassland.

pply from numerous perennial streams. Ground water abundant; easily develo

omber field; clear approaches. Rapid

AREA



SUGGESTED AIRDROME SITES

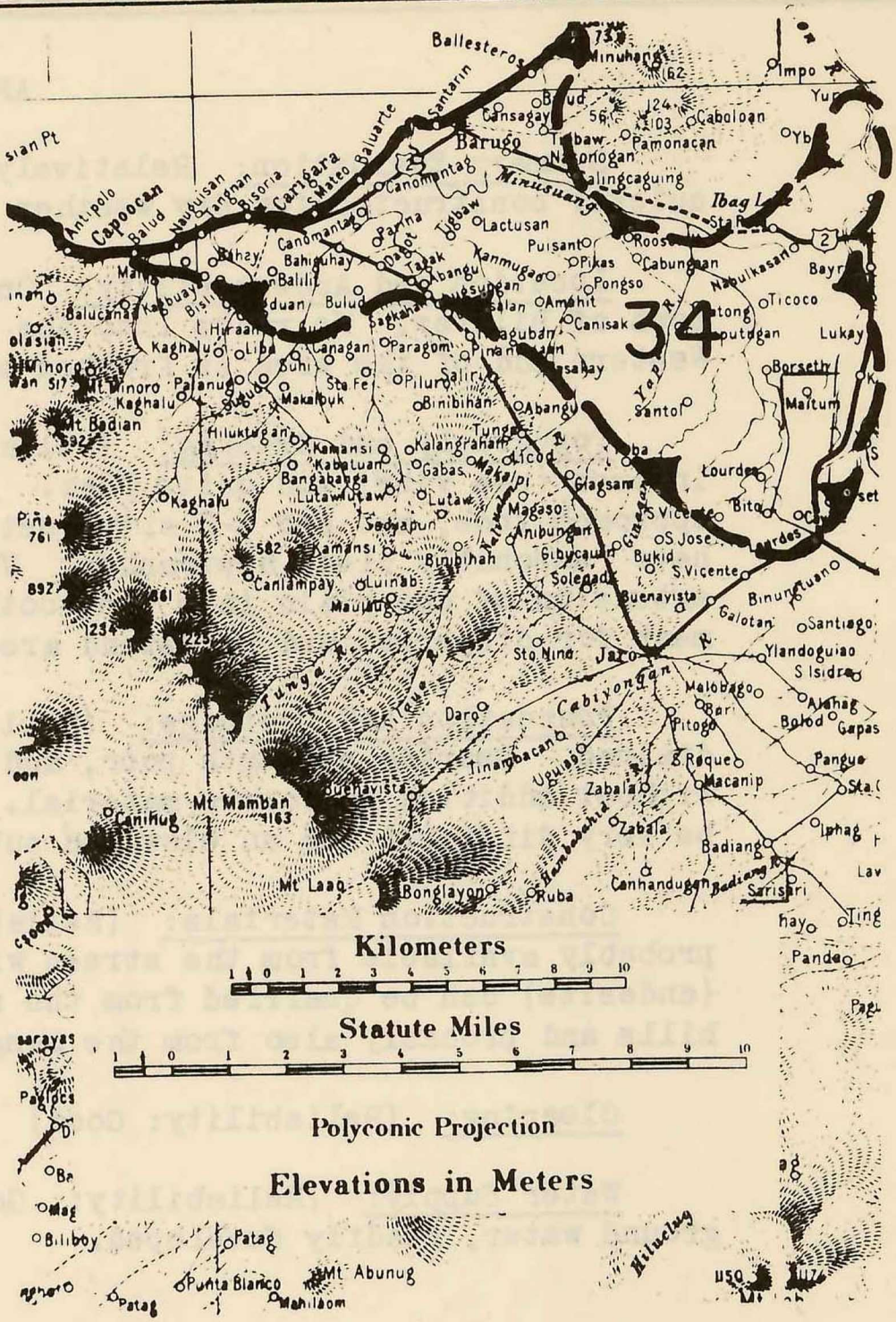
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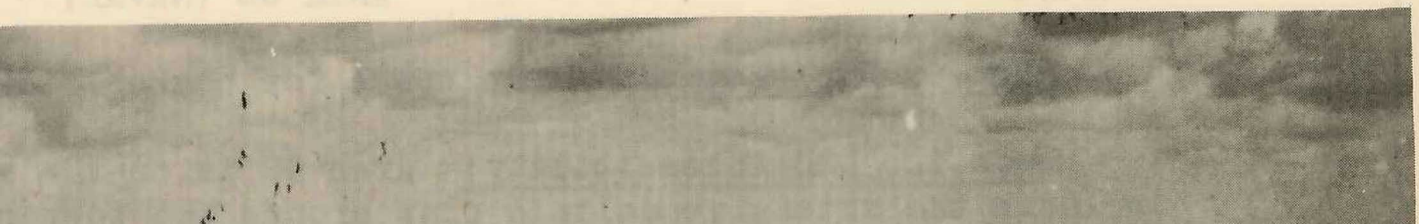
loam soil
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possibly

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34 (CARIGARA)



construction possible.

Location and Accessibility: On the northeast coa
of Bohol and Culuba. Area approximately 2 1/2 miles lo
roads into area. Sandy beach.

Topography and Grading: (Reliability: Good) Amp
the only orientation giving clear approaches at both en
streams would be necessary, but grading would be genera

Foundation and Drainage: (Reliability: Fair) Th
soil, with fair drainage and fair bearing strength. It
difficulty, but subgrade stabilization would require ad

Construction Materials: (Reliability: Fair) Abu
streams within less than a mile from coast. Excellent

Clearing and Grubbing: (Reliability: Good) Almo

Water Supply: (Reliability: Good) Good supply i
abundant; readily developed.

AREA 36 (CAIBIRA

Summary Evaluation: Area suitable for bomber or
only. Rapid construction possible.

Location and Accessibility: Deltaic flat on the
town of Caibiran. No roads into this area. Sandy bea

Topography and Grading: (Reliability: Good) Am
but approaches open only from east and north. Diversi
wise grading light.

Foundation and Drainage: (Reliability: Fair) S
near the streams. Bearing strength poor to fair; drai

Construction Materials: (Reliability: Fair) Ab
streams within less than a mile from coast. Good timb

Clearing and Grubbing: (Reliability: Good) Alm

st of Biliran Island, between the towns
ng by about one mile maximum width. No

le space for 6,000-foot runways, but
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e area is probably underlain by silty
probably can be drained without much
dition of coarse material.

ndant gravel probably in and near
timber in foothills.

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N)

fighter field with one way approach

east coast of Biliran Island, near the
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ple space is available for large runways,
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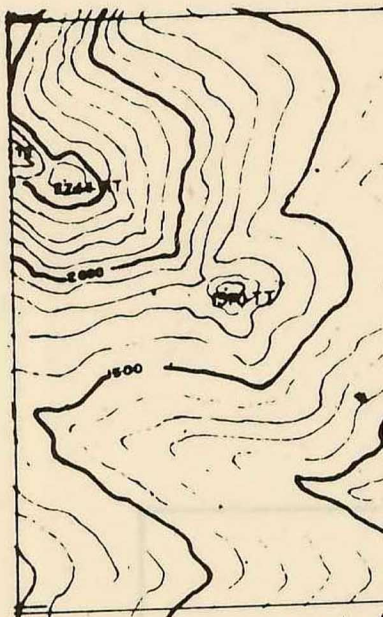
oil will be silty to clay loam, sandy
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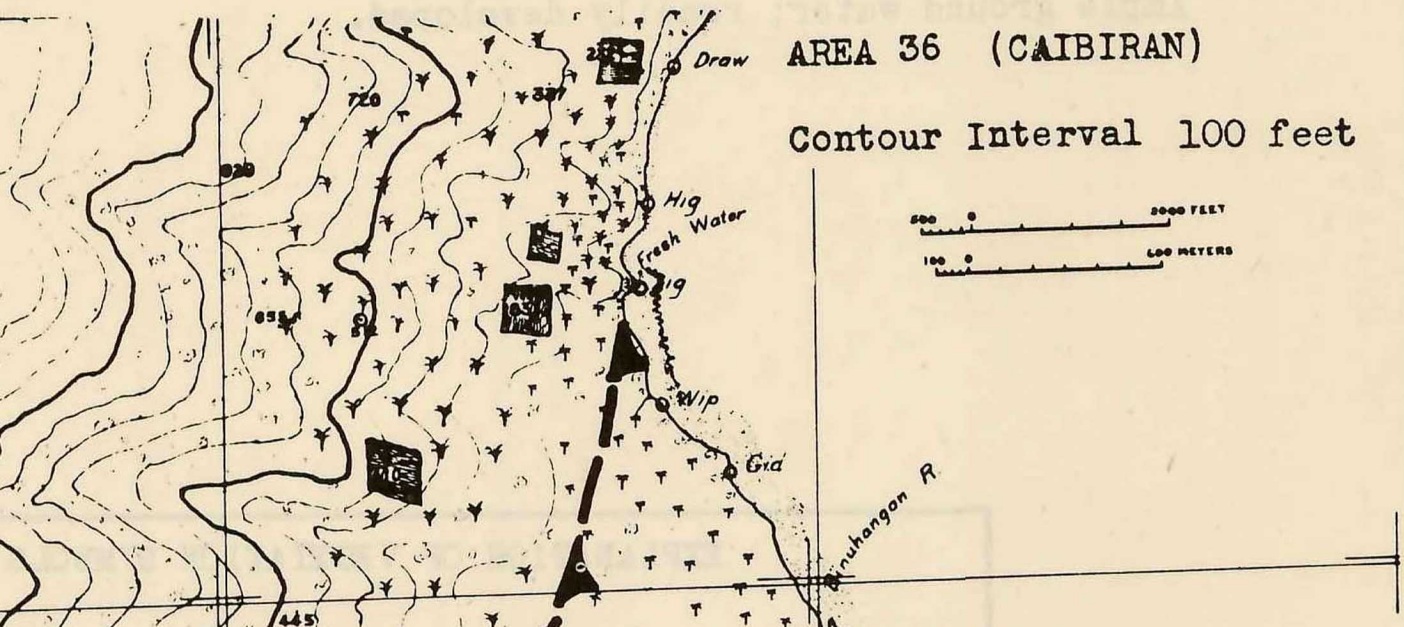


AREA 34. View of Carigara
View to southeast. (ONI 6





a and northwestern part of the northeast lowland of Leyte.
S2004)



AREA 36 (CAIBIRAN)

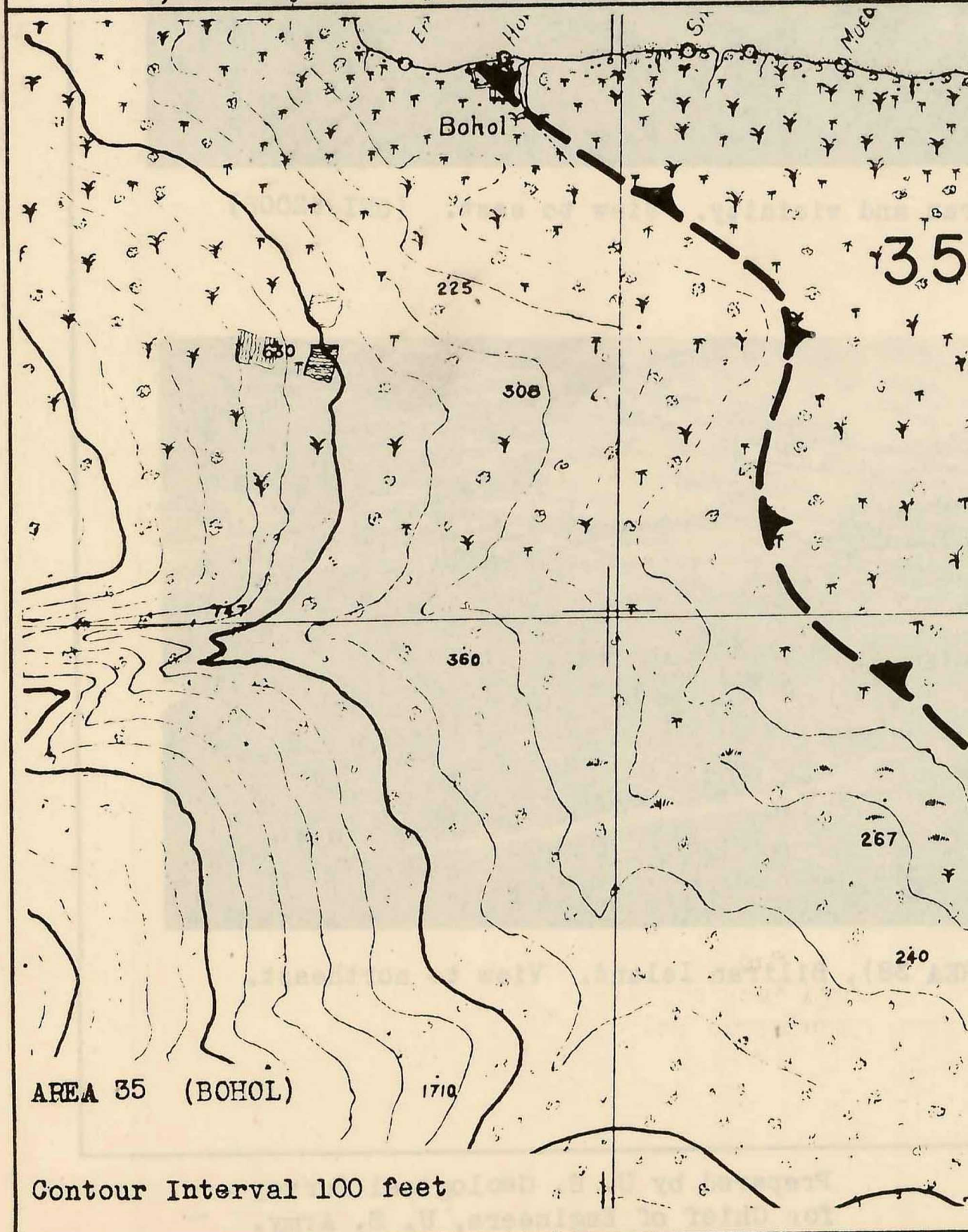
Contour Interval 100 feet

500 2000 FEET

100 600 METERS

Clearing and Grubbing: (Reliability:)

Water Supply: (Reliability: Good) Good supply water; readily developed.

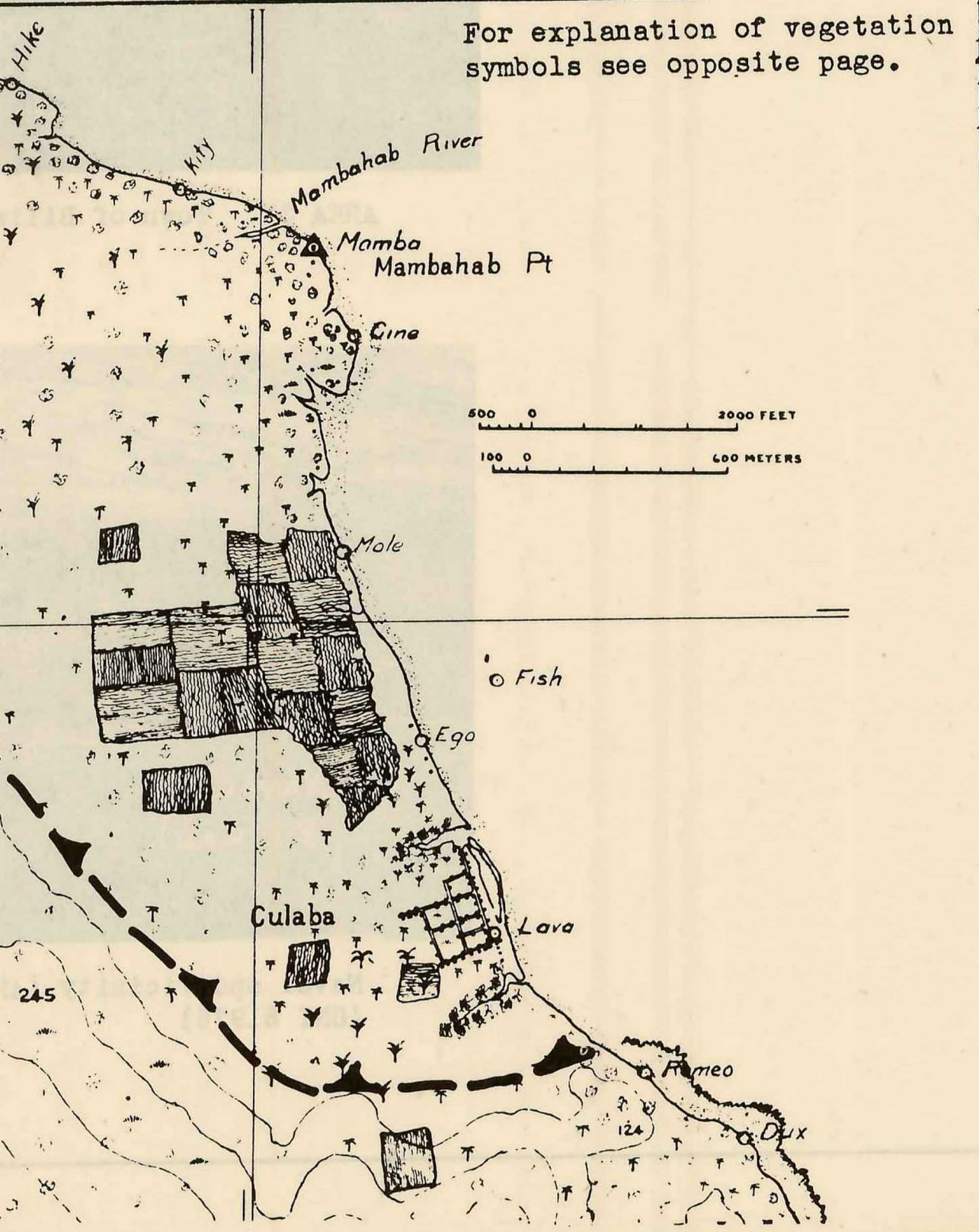


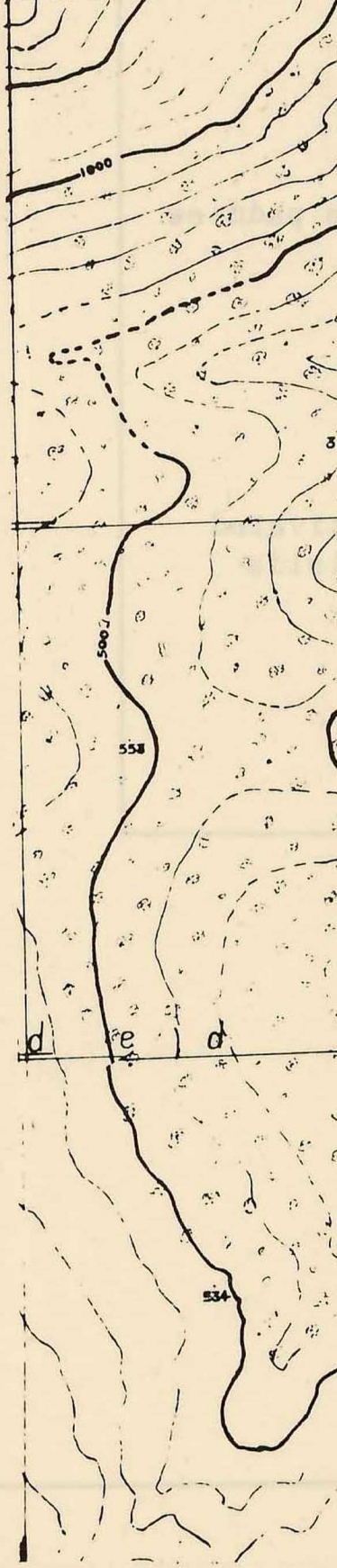
AREA 35 (BOHOL)

Contour Interval 100 feet

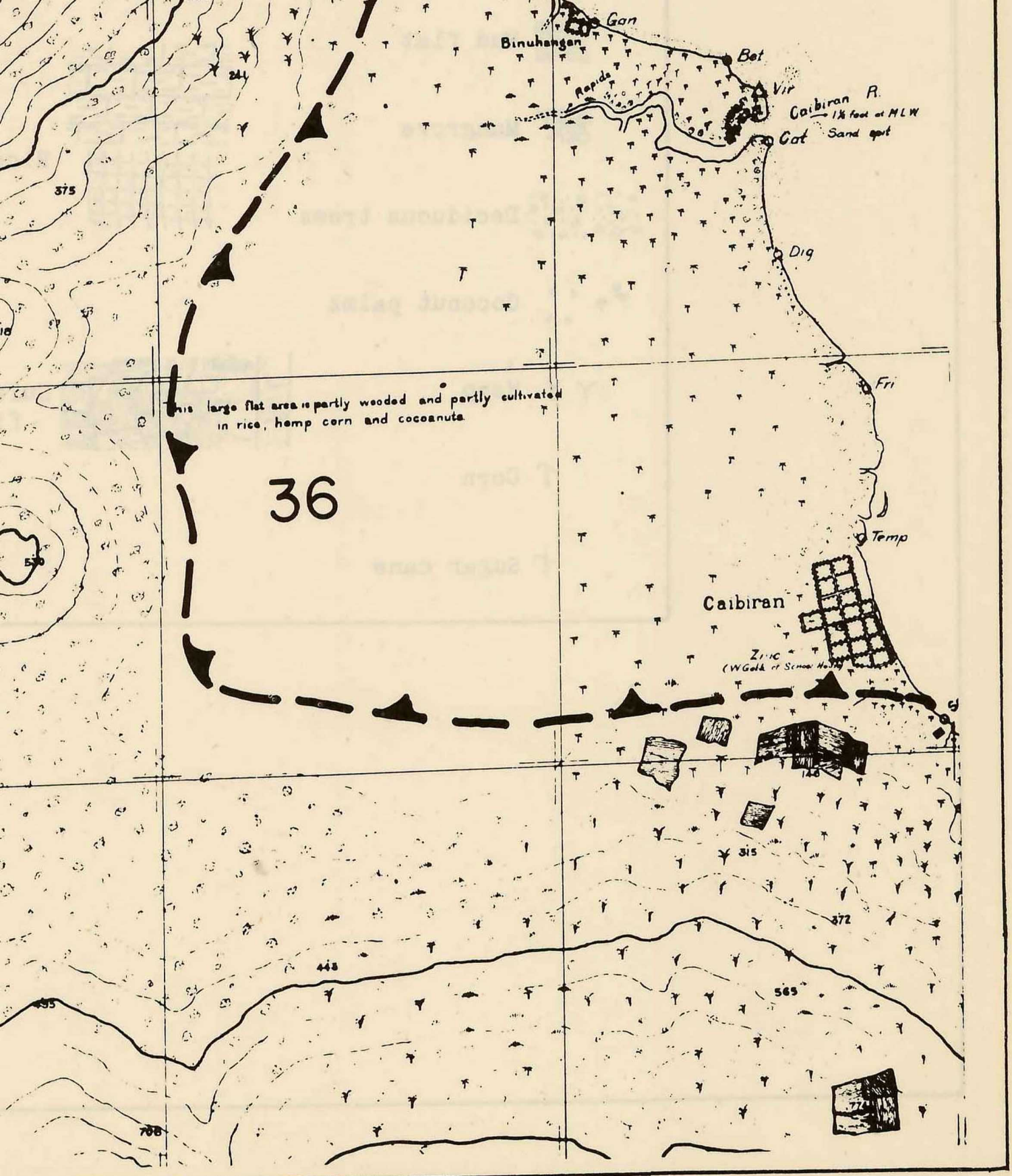
from perennial streams. **Abundant ground**

For explanation of vegetation symbols see opposite page.





CONFIDENTIAL



Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

AREA 37 (BILIRAN)

Summary Evaluation: Relatively small area; small fighter field could be quickly constructed for dry weather use.

Location and Accessibility: On the southwest tip of Biliran Island, near the town of Biliran. No roads into the area; however, there is a wharf at the town. Western end of the area is fronted by sandy beach.

Topography and Grading: (Reliability: Fair) The site is about a square mile in area (see view) and quite flat. A low hill blocks the northern part of the west approach zone, but and E-W site just north of the town and west of the river would have reasonably clear approaches. Very little grading required. The northern extension of the plain into the foothills would provide good cover and fair concealment for dispersal and hardstand areas.

Foundation and Drainage: (Reliability: Fair) Soil is silt or clay loam, poorly drained. Bearing strength poor, and the soil could not be mechanically stabilized without addition of coarse material. Because of the low elevation, drainage may be very difficult and an elevated subgrade necessary.

Construction Materials: (Reliability: Fair) No specific information. Gravel probably available from the stream within 1 1/2 miles of the coast; very good stone (andesite) can be quarried from the nearby hills. Timber available from the foothills and probably also from the mangrove swamps just west of town.

Clearing: (Reliability: Good) Almost negligible.

Water Supply: (Reliability: Good) Good supply from perennial streams. Ample ground water, readily developed.

AREA 38 (NAVAL)

Summary Evaluation: Ample space for bomber field; drainage and soil poor.

Location and Accessibility: Area 38 is on the west side of Biliran Island and includes the extensive deltaic flat around the town of Naval, and the coastal plain to a point about a mile south of the barrio of Busali. Accessible only by boat; there is a small dock at the town of Naval; the northern part is generally fronted by sand beaches.

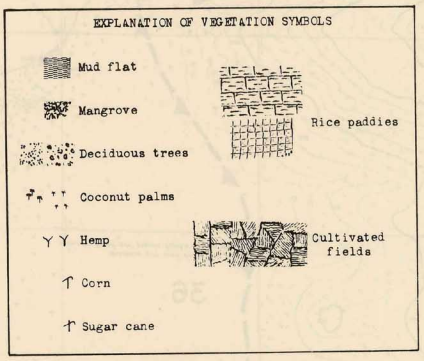
Topography and Grading: (Reliability: Fair) As shown in the view, the topography in the immediate vicinity of Naval is quite flat, largely wet-paddy fields, for about 2 miles inland and would require very little grading. Beyond this the plain slopes gently to the foothills. Two streams drain across this flat, one about a mile north of the town and one about 1 1/2 to 2 miles south. This leaves an intervening area of several square miles cut only by very minor drainage channels. Ample space is avilable for runways of any orientation, inland approaches impeded by foothills. Runways near the shore and oriented NNW would have open approach zones. There is plenty of space for dispersal, but little or no concealment.

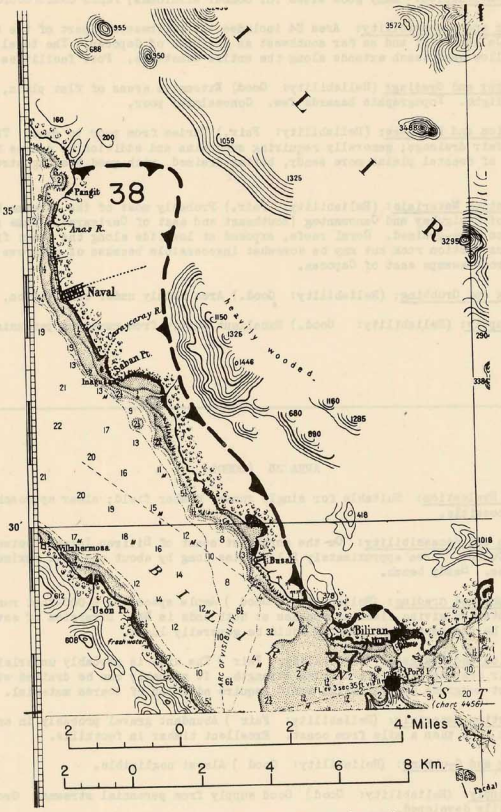
Foundation and Drainage: (Reliability: Fair) The soil of the flat area on the coast near Naval is poorly drained, silty or clayey, with low bearing strength. Drainage will be difficult because of the low elevation; the site would probably require an elevated subgrade. The more inaccessible and topographically less suitable areas of coastal plain south of Naval are probably underlain by more favorable sandy soil.

Construction Materials: (Reliability: Fair) Volcanic rock (andesite), very suitable as construction stone, is exposed in the surrounding hills; good gravel available in the beds of the streams at the inner edge of the plain (probably about three miles from shore). Coral is probably available at low tide from the reefs that begin about two miles north of Naval. Timber for construction available from either the mangrove swamps at the mouth of the Carayearay River or the mountainous country back from the coast.

Clearing: (Reliability: Good) The area is practically clear except for a few coconut palms that can be taken out with dozers.

Water Supply: (Reliability: Good) Abundant supply from perennial streams. Ample ground water; readily developed.





AREA 37 (BILIRAN) AND AREA 38 (NAVAL)

Contour Interval 100 feet



AREA 37. Town of Biliran and vicinity. View to east. (ONI 62008)



Naval and vicinity (AREA 38), Biliran Island. View to northeast. (ONI 61976)

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SUGGESTED AIRDROME SITES

AREA 37 (BILIRAN)

Summary Evaluation: Relatively small area; sm
quickly constructed for dry weather use.

Location and Accessibility: On the southwest
town of Biliran. No roads into the area; however,
Western end of the area is fronted by sandy beach.

Topography and Grading: (Reliability: Fair)
in area (see view) and quite flat. A low hill bloc
approach zone, but and E-W site just north of the t
have reasonably clear approaches. Very little grad
extension of the plain into the foothills would pro
ment for dispersal and hardstand areas.

Foundation and Drainage: (Reliability: Fair)
drained. Bearing strength poor, and the soil could
without addition of coarse material. Because of th
be very difficult and an elevated subgrade necessar

Construction Materials: (Reliability: Fair)
probably available from the stream within 1 1/2 mil
(andesite) can be quarried from the nearby hills.
hills and probably also from the mangrove swamps ju

Clearing: (Reliability: Good) Almost negligi

Water Supply: (Reliability: Good) Good supp
ground water, readily developed.

AREA 38 (NAVAL)

Summary Evaluation: Ample space for bomber f

Location and Accessibility: Area 38 is on the

nall fighter field could be

tip of Biliran Island, near the
there is a wharf at the town.

The site is about a square mile
cks the northern part of the west
town and west of the river would
ding required. The northern
ovide good cover and fair conceal-

Soil is silt or clay loam, poorly
d not be mechanically stabilized
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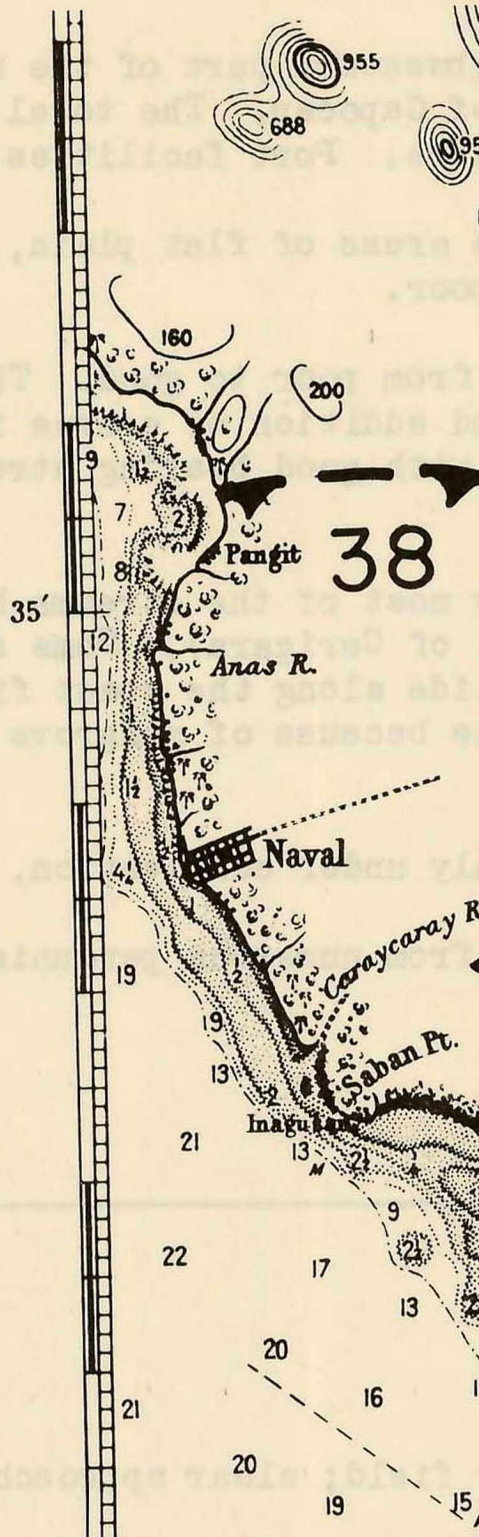
No specific information. Gravel
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Timber available from the foot-
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ible.

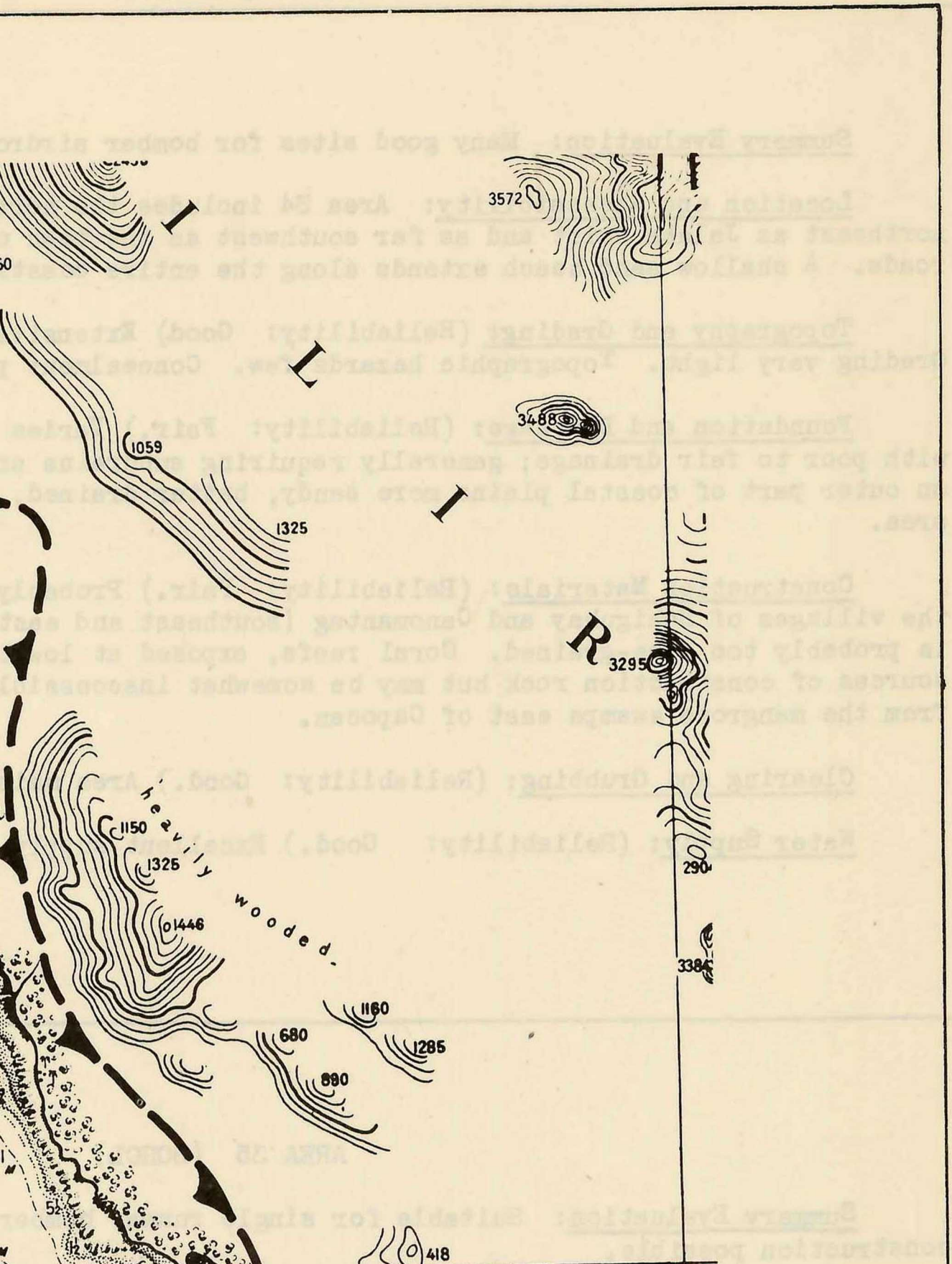
ply from perennial streams. Ample

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n of Naval, and the coastal plain



SAMAR AND LEYTE (P.I.)



includes the extensive deltaic flat around the tow
to a point about a mile south of the barrio of Busa
there is a small dock at the town of Naval; the nor
by sand beaches.

Topography and Grading: (Reliability: Fair)
topography in the immediate vicinity of Naval is qu
for about 2 miles inland and would require very li
plain slopes gently to the foothills. Two streams
a mile north of the town and one about 1 1/2 to 2 m
intervening area of several square miles cut only
Ample space is avilable for runways of any orienta
by foothills. Runways near the shore and oriented
There is plenty of space for dispersal, but little

Foundation and Drainage: (Reliability: Fair)
coast near Naval is poorly drained, silty or claye
Drainage will be difficult because of the low eleva
require an elevated subgrade. The more inaccessib
suitable areas of coastal plain south of Naval are
favorable sandy soil.

Construction Materials: (Reliability: Fair)
suitable as construction stone, is exposed in the
available in the beds of the streams at the inner
about three miles from shore). Coral is probably
reefs that begin about two miles north of Naval.
from either the mangrove swamps at the mouth of th
mountainous country back from the coast.

Clearing: (Reliability: Good) The area is p
coconut palms that can be taken out with dozers.

Water Supply: (Reliability: Good) Abundant
Ample ground water; readily developed.

EXPLANATION OF VEGETATION SYM

ali. Accessible only by boat;
rthern part is generally fronted

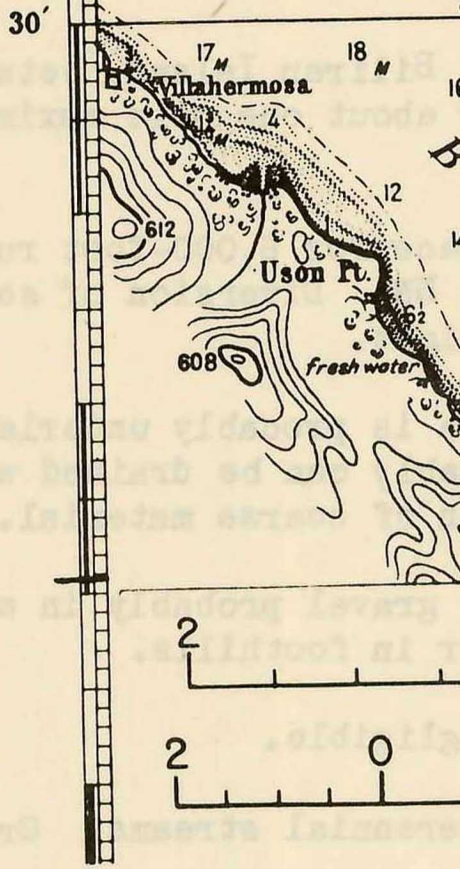
As shown in the view, the
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tion, inland approaches impeded
NNW would have open approach zones.
or no concealment.

The soil of the flat area on the
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le and topographically less
probably underlain by more

Volcanic rock (andesite), very
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Timber for construction available
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supply from perennial streams.

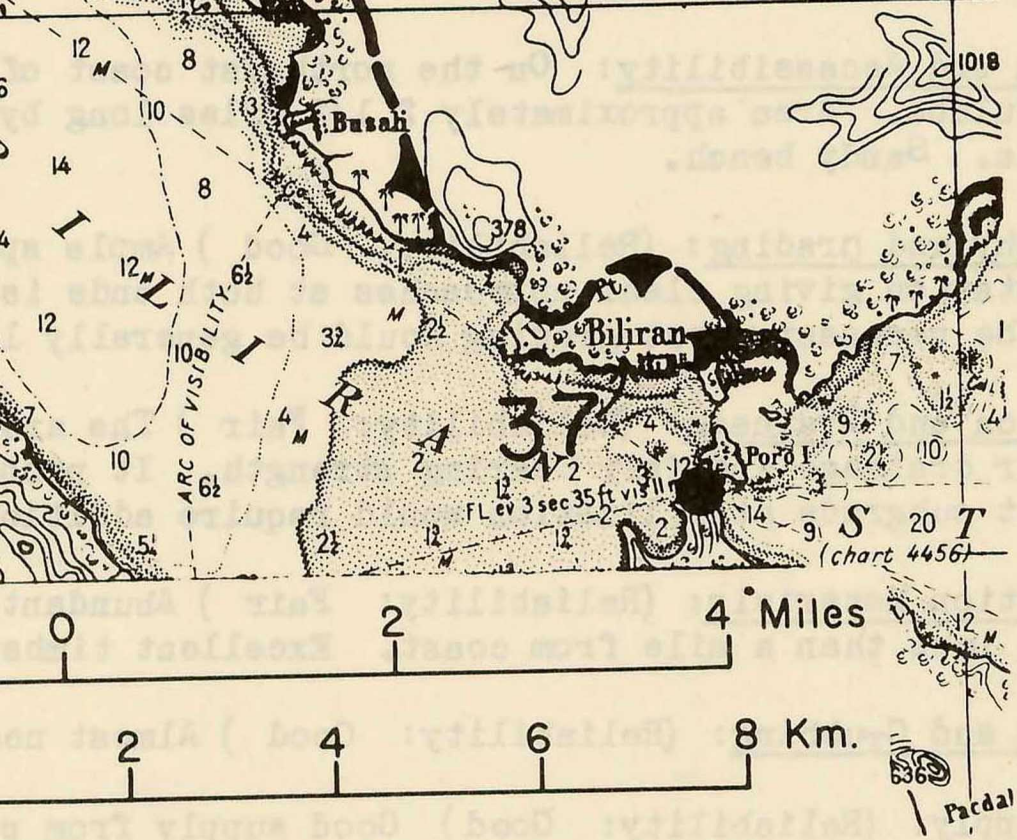


AREA 3

Contou



BOLS



37 (BILIRAN) AND AREA 38 (NAVAL)

ur Interval 100 feet



Mud flat

Mangrove

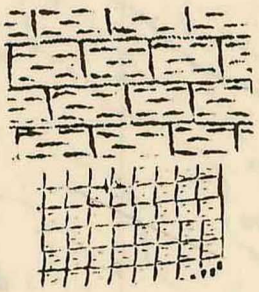
Deciduous trees

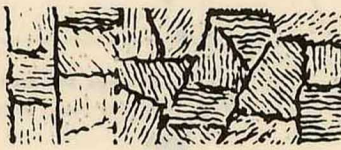
Coconut palms

Hemp

Corn

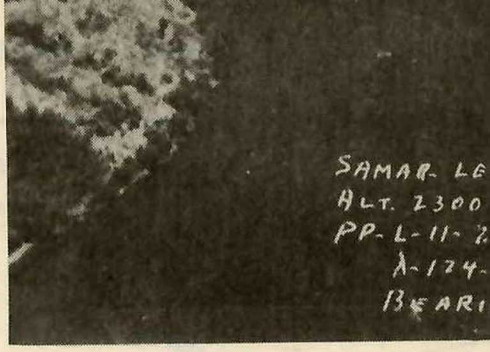
Sugar cane



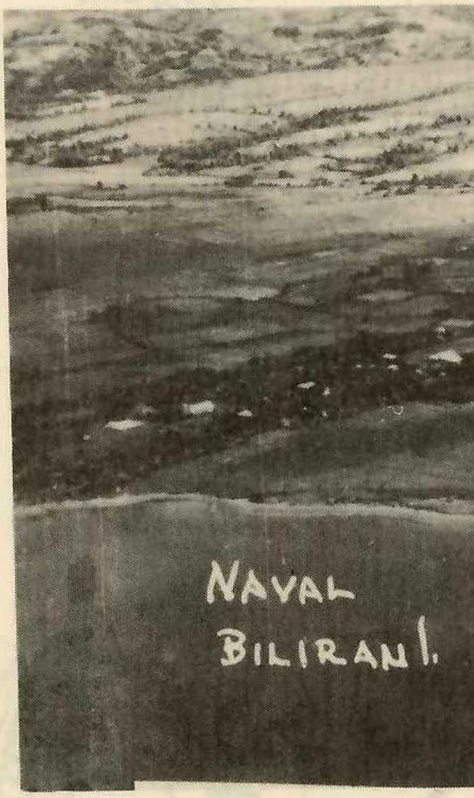


Rice paddies

Cultivated fields

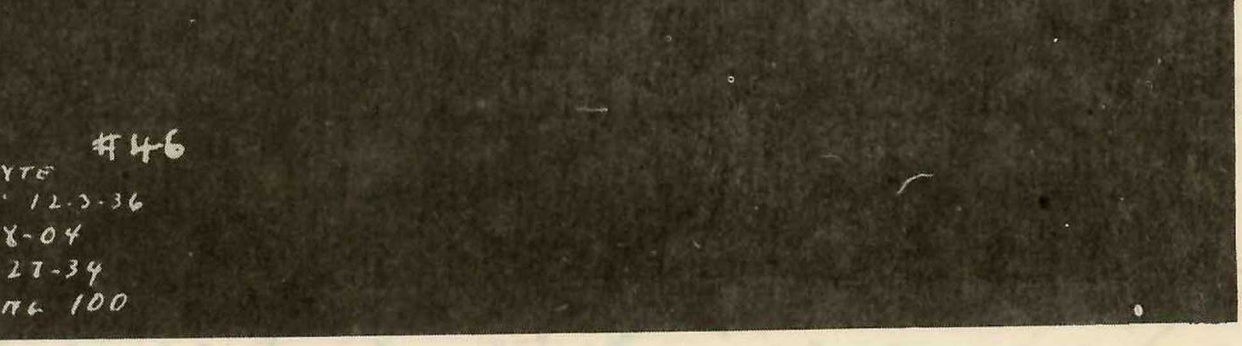


AREA 37. Town c

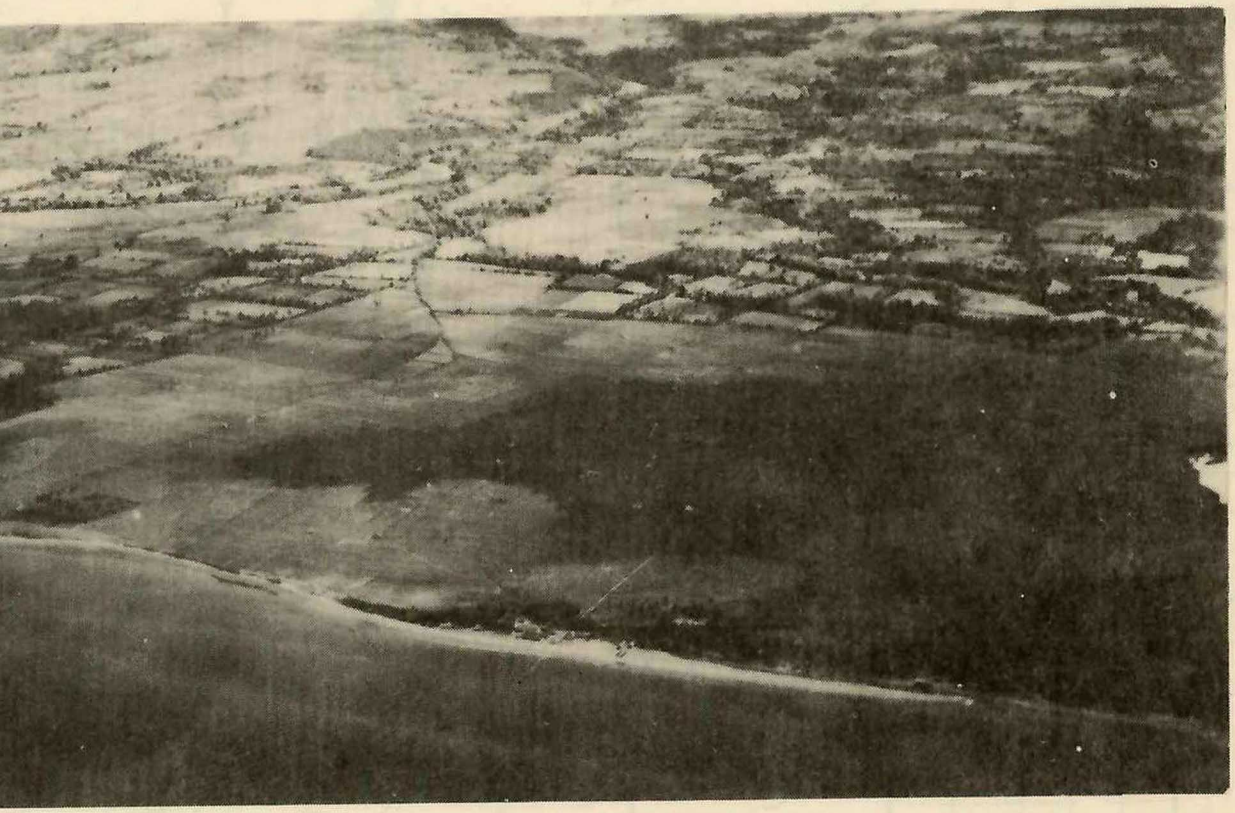


Naval and vici
(ONI 61976)

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of Biliran and vicinity. View to east. (ONI 62008)

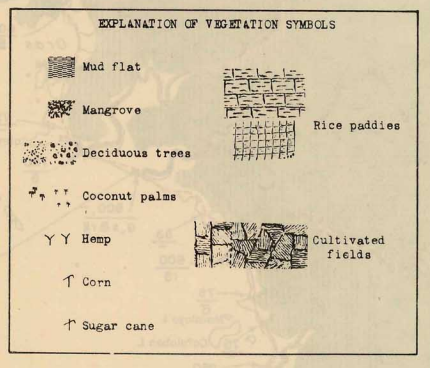


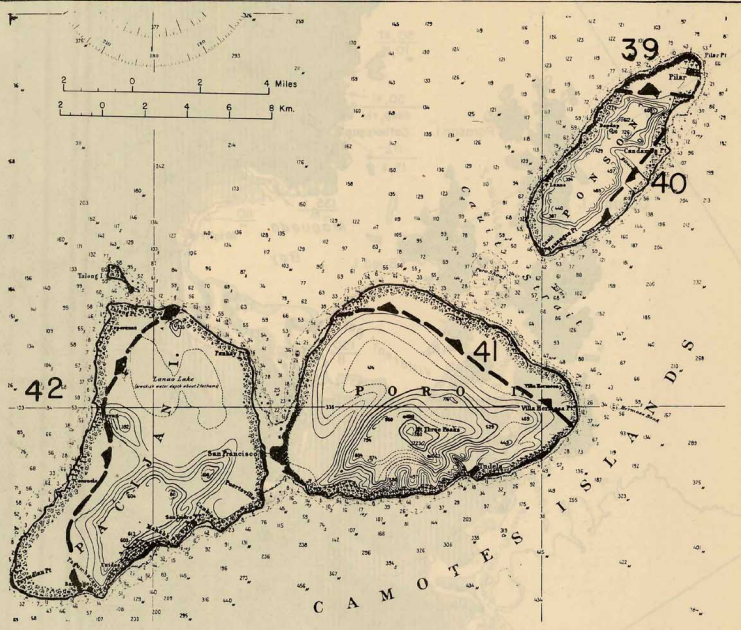
nity (AREA 38), Biliran Island. View to northeast.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

SUGGESTED AIRDROME SITES





AREAS 39, 40, 41, 42

Contour Interval 100 feet

AREAS 39, 40, 41, 42 (CAMOTES ISLANDS)

Summary Evaluation: Several excellent sites for quick construction of bomber or fighter fields.

Location and Accessibility: The Camotes Islands (Ponson, Poro, and Pacijan) are located 11 to 35 miles off the west coast of Leyte. Pacijan and Poro, which are connected by road across the narrow reef flat, are almost encircled by good roads. A coastal road traverses the western half of Ponson Island. No harbor facilities on the islands.

Topography and Grading: (Reliability: Fair) The areas outlined are all relatively flat coastal strips underlain by recent coral-reef deposits. Each area outlined is large enough to accomodate at least one 6,000-foot runway with clear approach zones, together with adequate space for dispersal and hardstands. In general the ground is flat and in part sand covered, but there are numerous exposures of coral and locally some of the ground may be very uneven; grading will encounter hard to semiconsolidated coral rock, some of which would require blasting. Areas 39, 40, and 41 are rimmed with shore bluffs about 20 feet high, from which the surface probably slopes to slightly lower elevations inland before rising to the crests of the islands. The only known local obstructions within the outlined areas are some low hills, probably less than 50 feet in elevation, in the eastern part of Area 40.

Foundation and Drainage: (Reliability: Fair) The areas outlined are underlain by recent coral reef deposits that consist of hard coral, coral sand, and lenses of sand and silt. Generally, this bedrock is more or less porous and permeable, but locally, particularly in the area between the coastal ridges and the foothills, silty beds may predominate. This factor, combined with somewhat lower elevation of such areas, may cause very poor drainage conditions, such as exist in the northern part of Pacijan Island, where there is a large brackish-water lake. In general, however, drainage will be good in sections within half a mile or a mile of the coast. Foundation conditions will likewise be dependent on the position. The coastal strip is underlain by sandy soils or semiconsolidated coral, both of which will have good bearing strength and can be stabilized mechanically, whereas soils of the inner lowland may by locally silty or clayey, with low bearing strength and poor drainage. However, coarse fractions for stabilization can be obtained from exposed coral deposits within relatively short distances.

Construction Materials: (Reliability: Good) Rock for construction purposes should be available almost everywhere from inland coral terraces. Locally, sand is available in small quantities. No timber on the islands, except possibly from mangrove swamps on the west side of Poro Island, and on the northern tip of Ponson Island.

Clearing and Grubbing: (Reliability: Poor) The islands are reported to be largely under cultivation, although much of the area has doubtless reverted to brush and cogon grass. The numerous coconut palm groves can be cleared with dozers.

Water Supply: (Reliability: Fair) Little surface water available, but adequate supply of ground water could be developed back from coast.

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FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE(P.I.)

EXPLANATION OF VEGETATION SYMBOLS

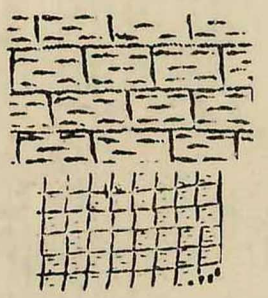
Mud flat

Mangrove

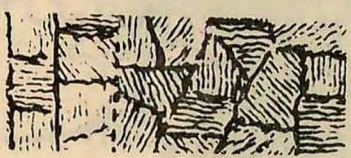
Deciduous trees

Coconut palms

Hemp

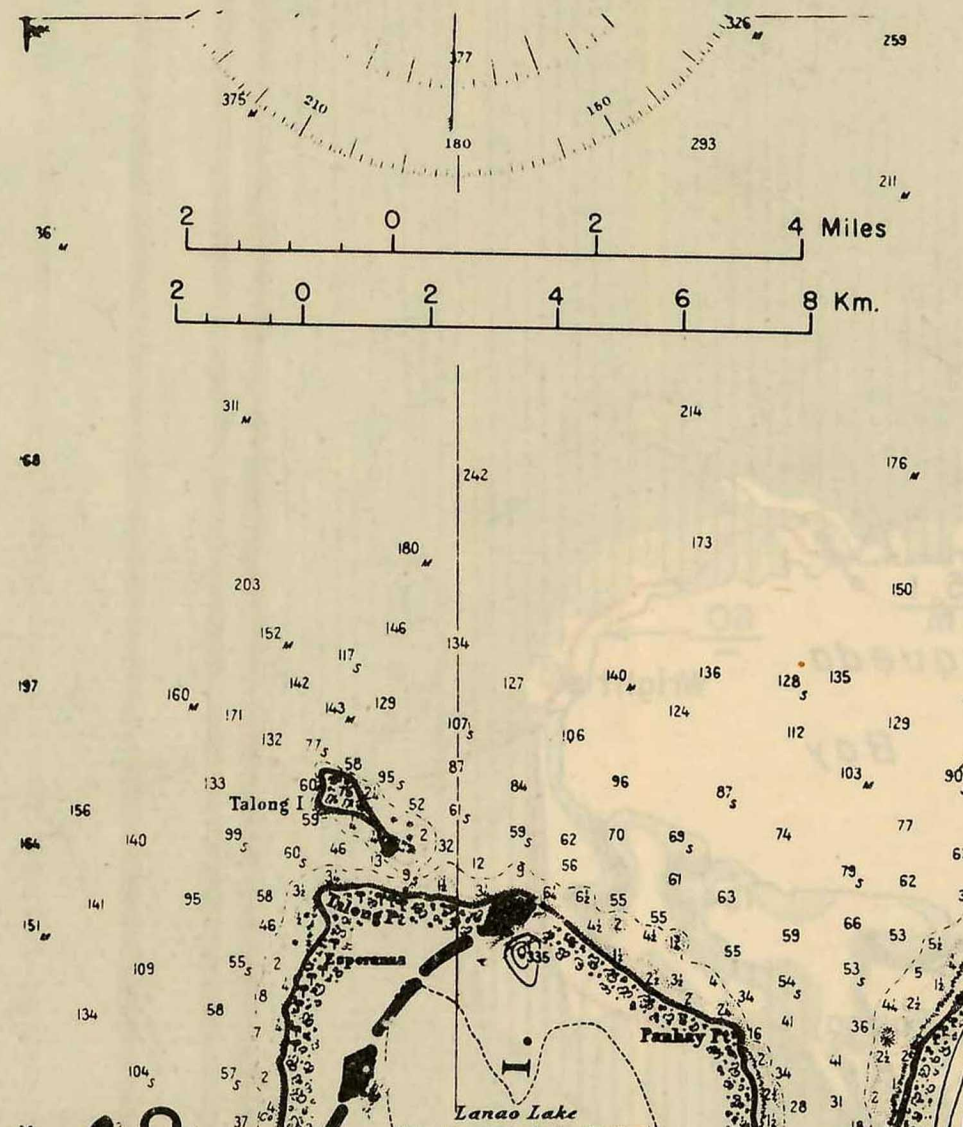


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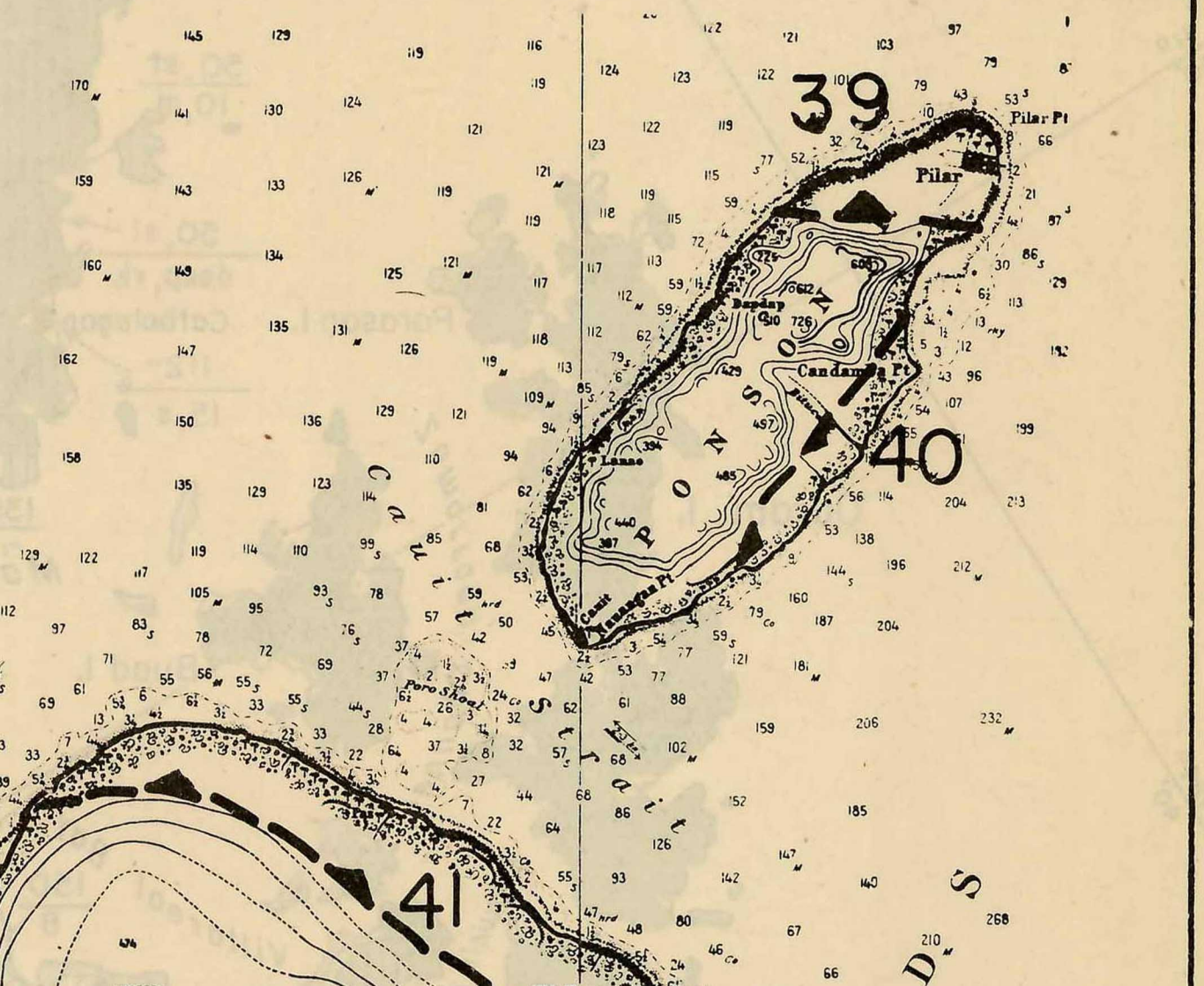
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SUGGESTED AIRDROME SITES



† Corn

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Summary

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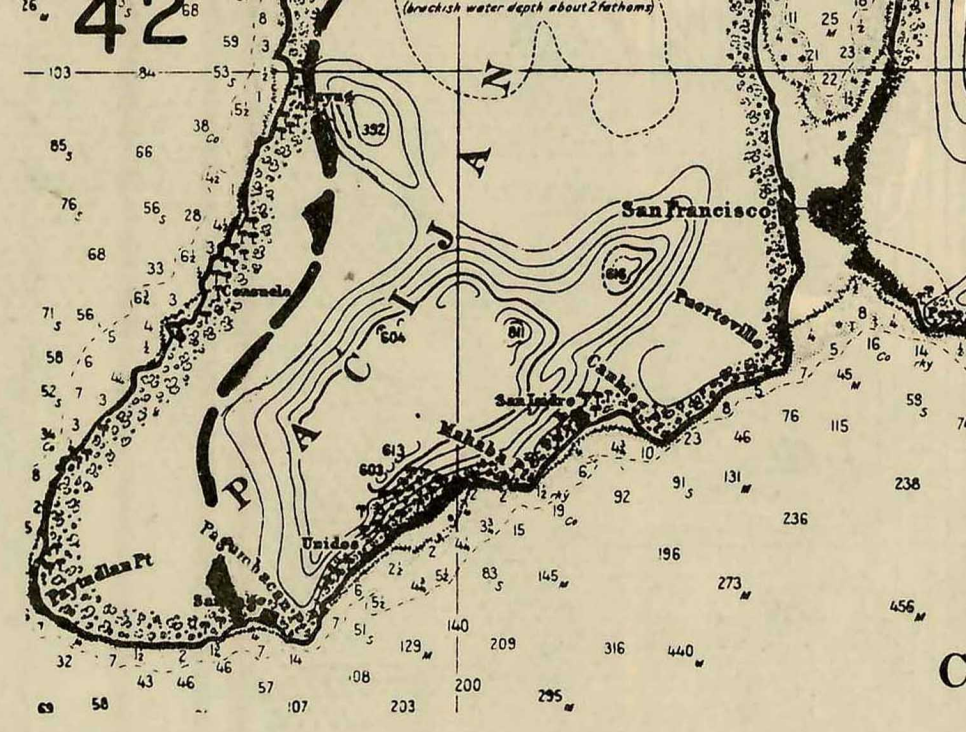
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AREAS 39, 40, 41, 42

Contour Interval 100 feet

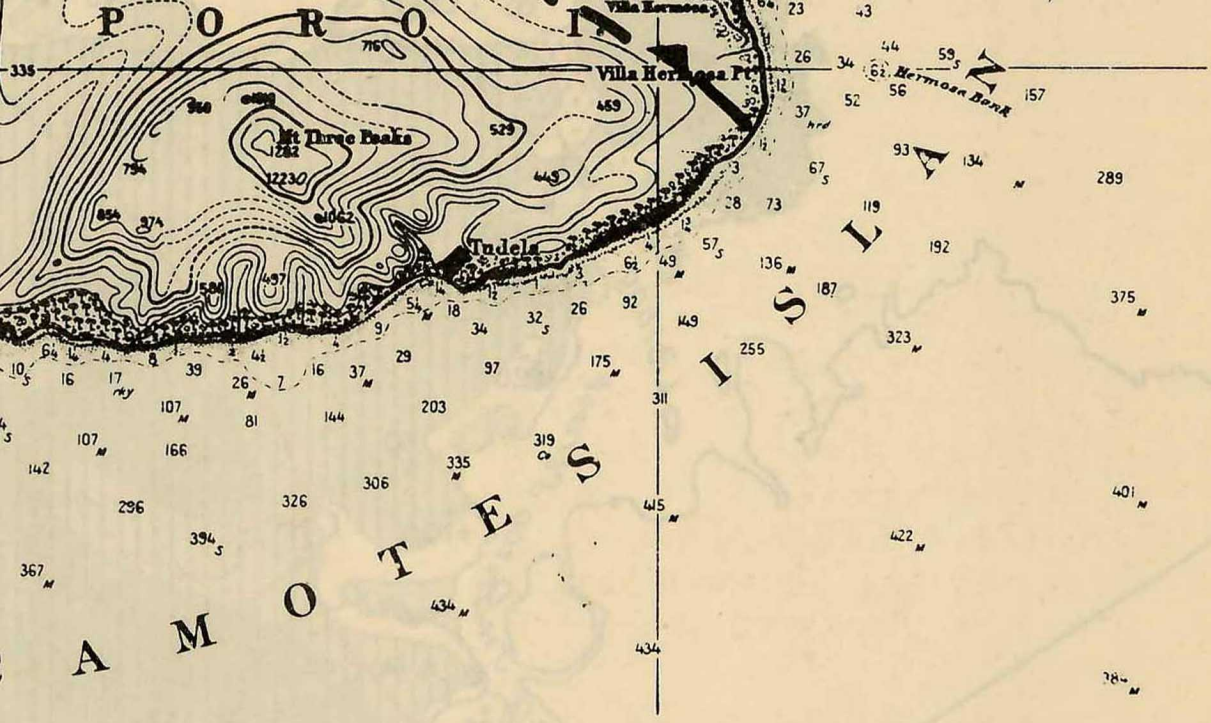
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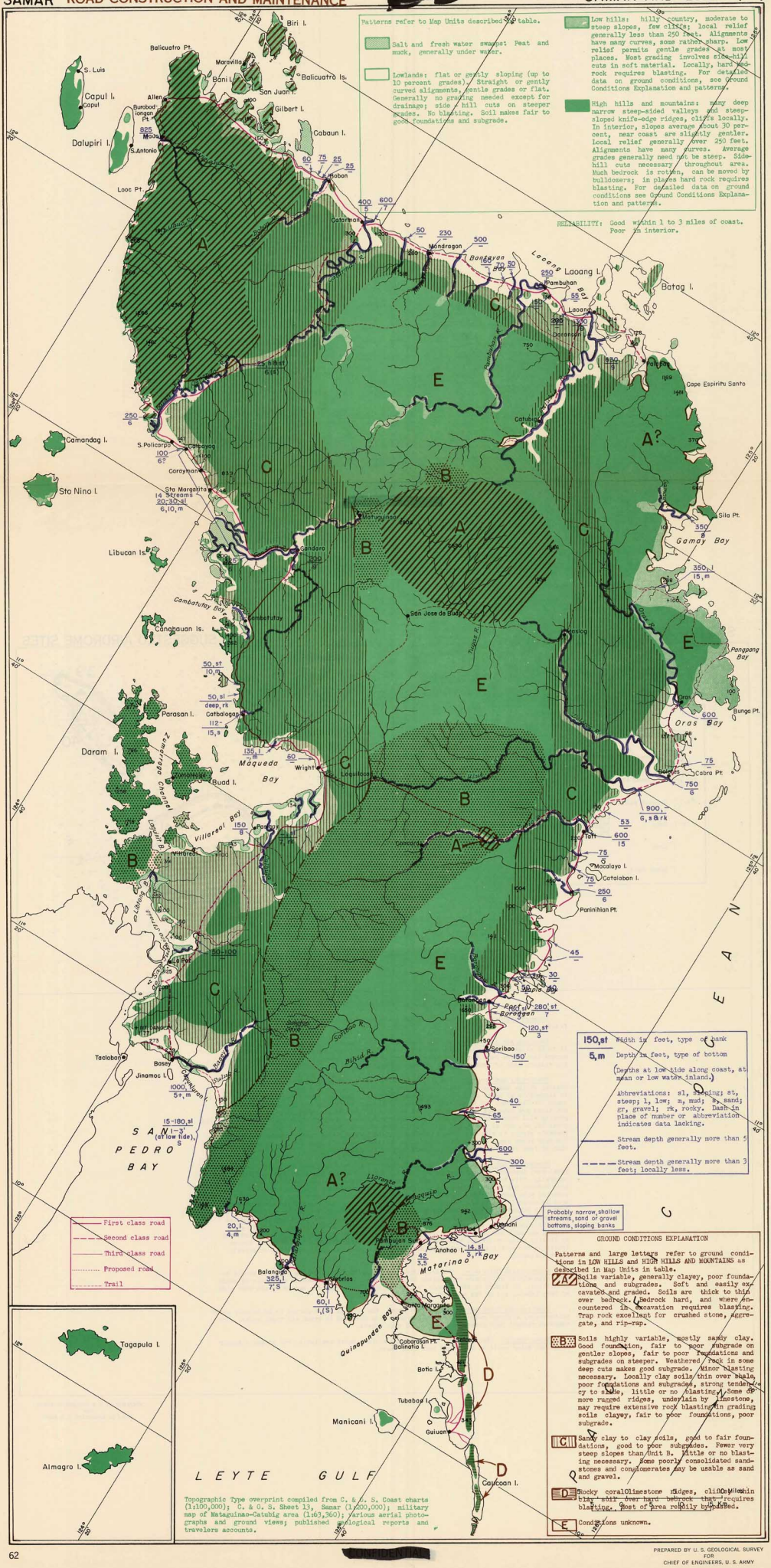
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FOR
CHIEF OF ENGINEERS, U. S. ARMY

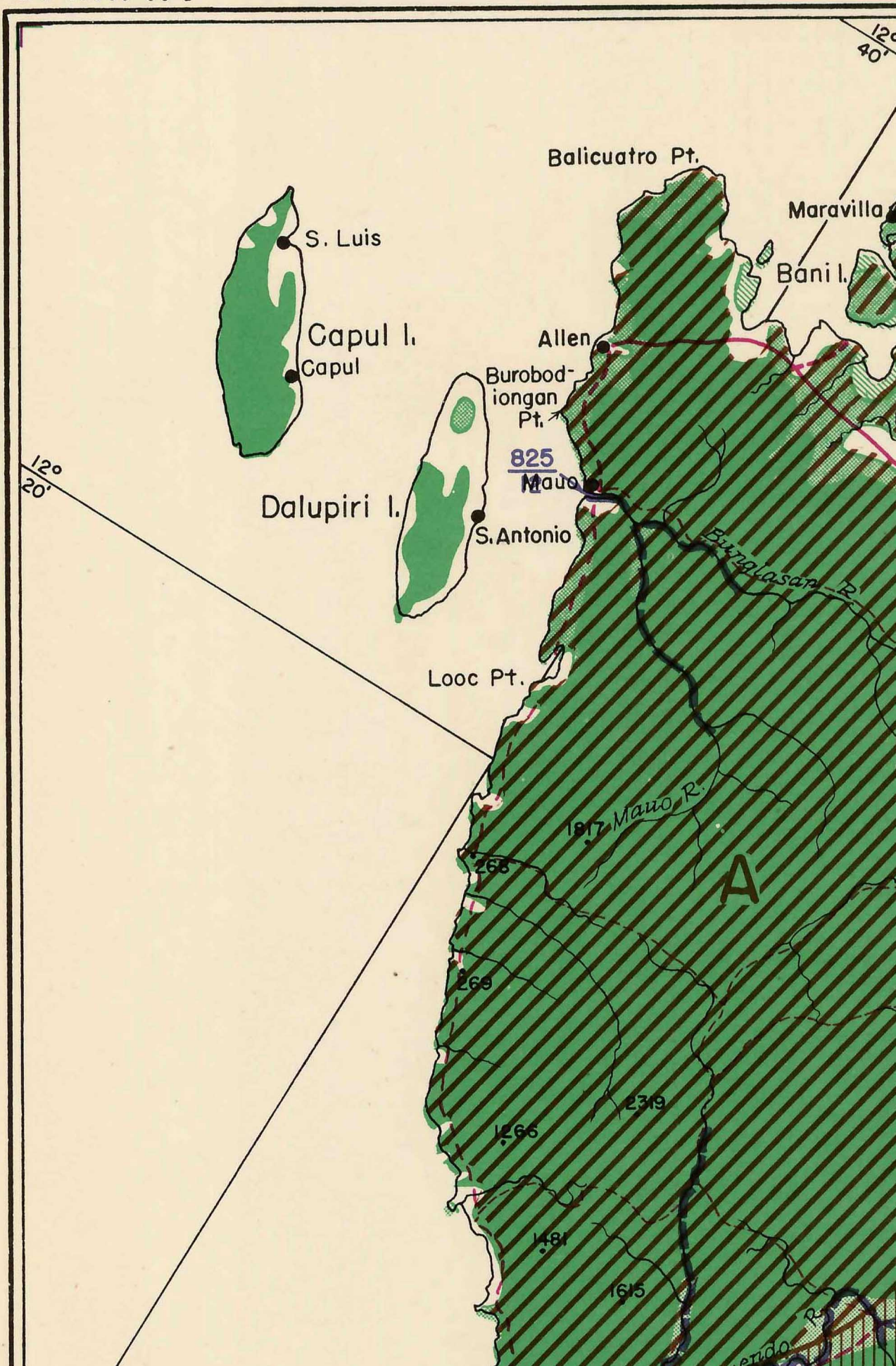
SAMAR ROAD CONSTRUCTION AND MAINTENANCE

SAMAR AND LEYTE (P.I.)



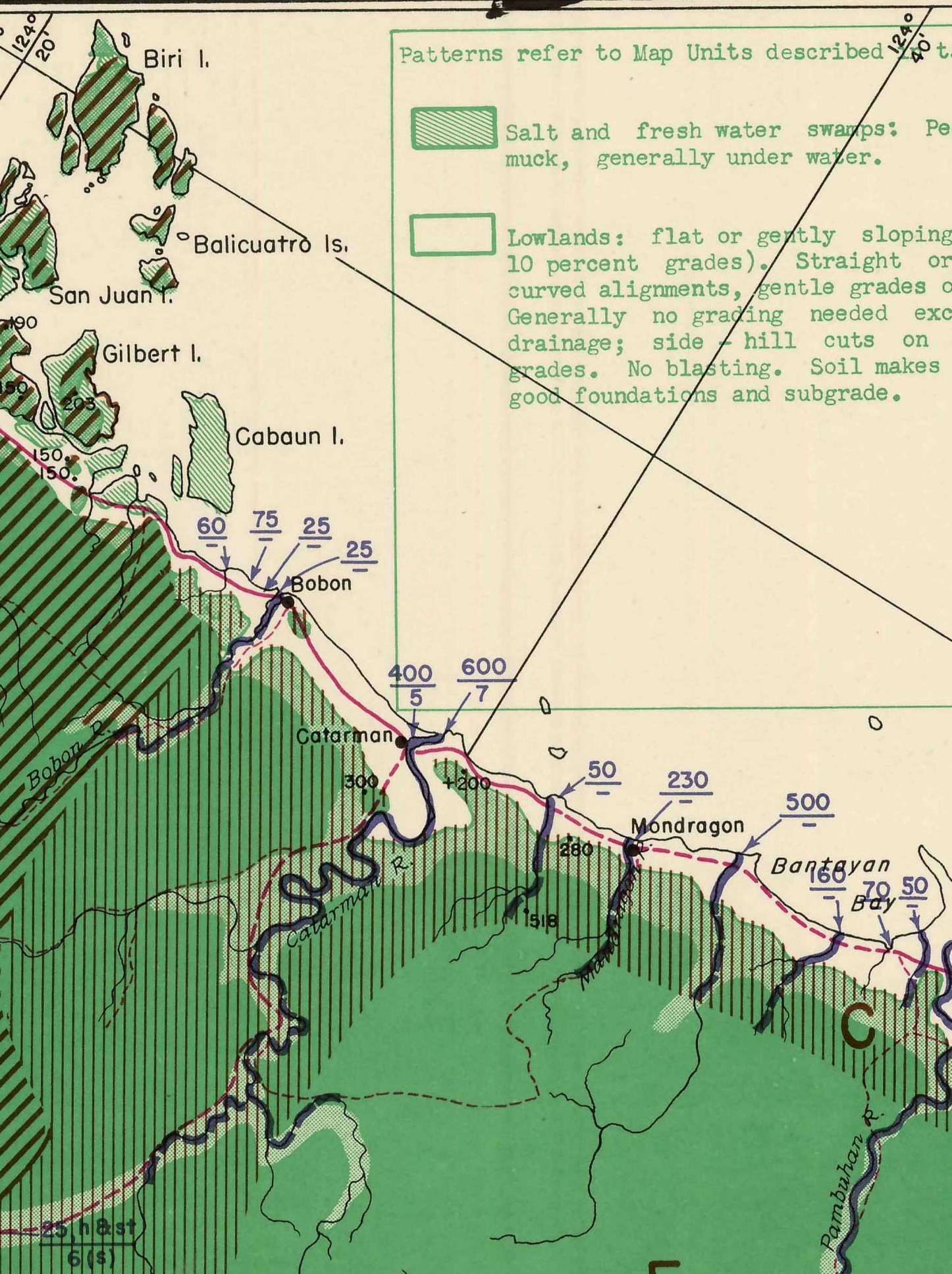
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SAMAR ROAD CONSTRUCTION AND



MAINTENANCE

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SAMAR AND LEYTE (P.I.)

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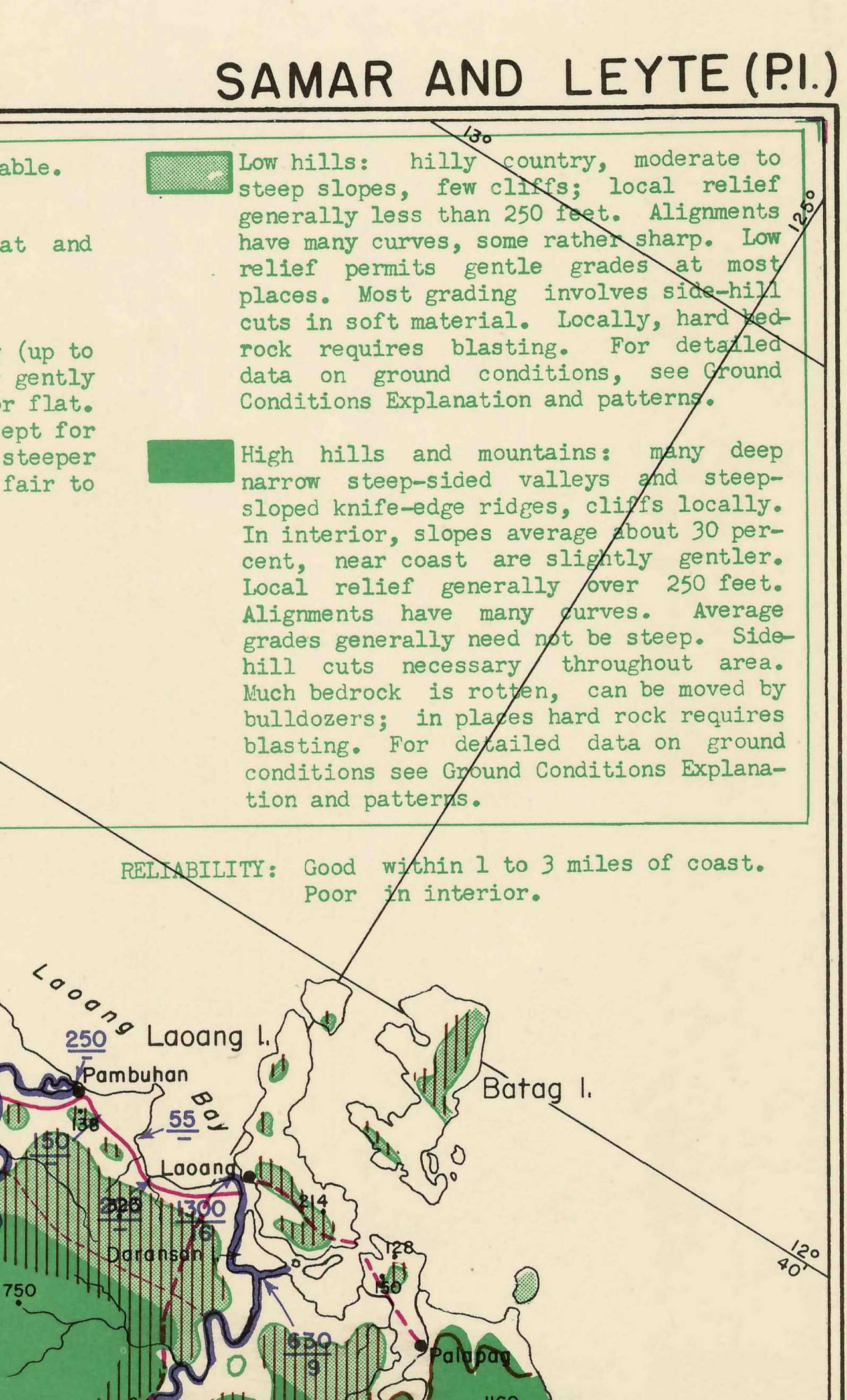
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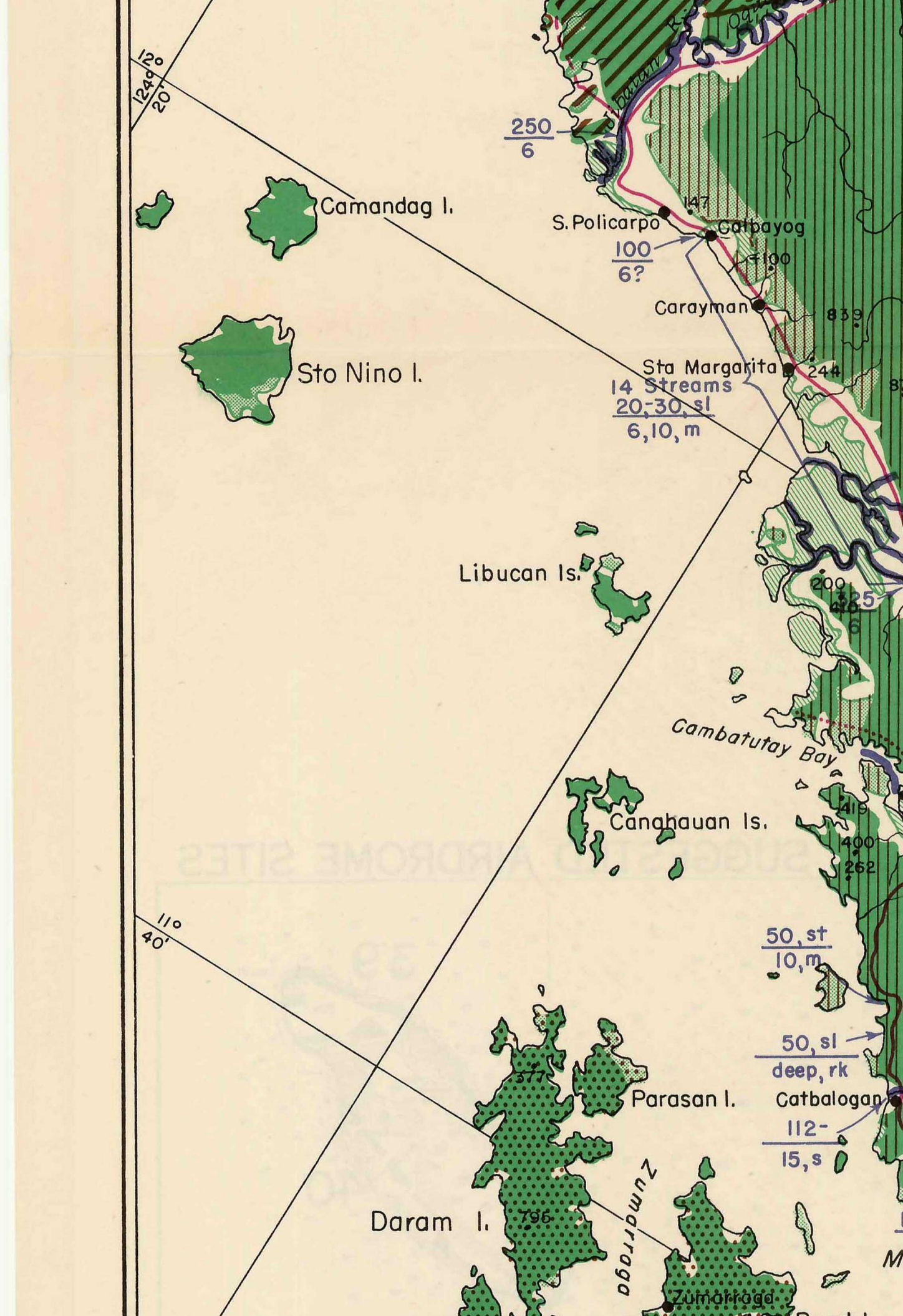
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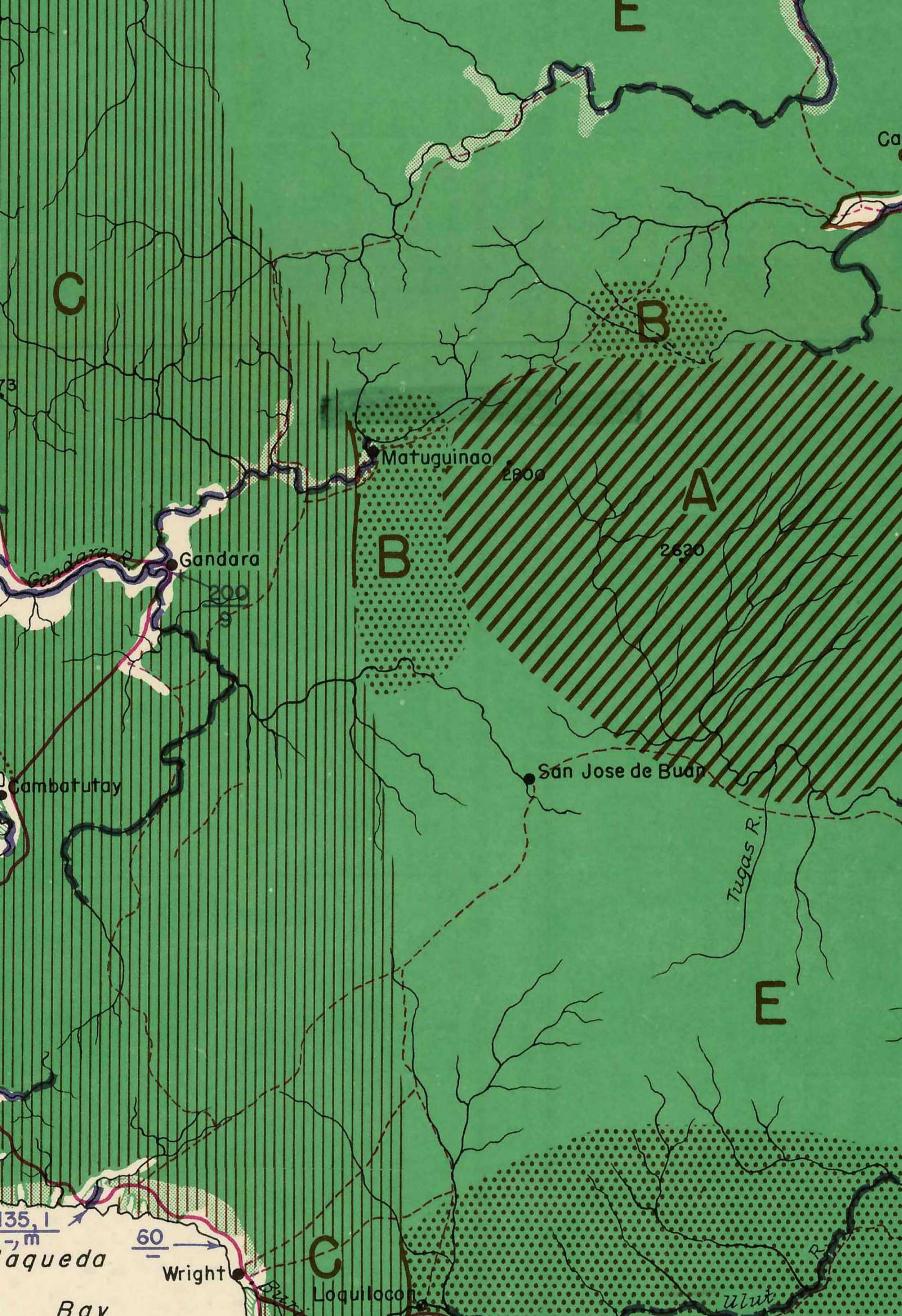
Low hills: hilly country, moderate to steep slopes, few cliffs; local relief generally less than 250 feet. Alignments have many curves, some rather sharp. Low relief permits gentle grades at most places. Most grading involves side-hill cuts in soft material. Locally, hard bedrock requires blasting. For detailed data on ground conditions, see Ground Conditions Explanation and patterns.

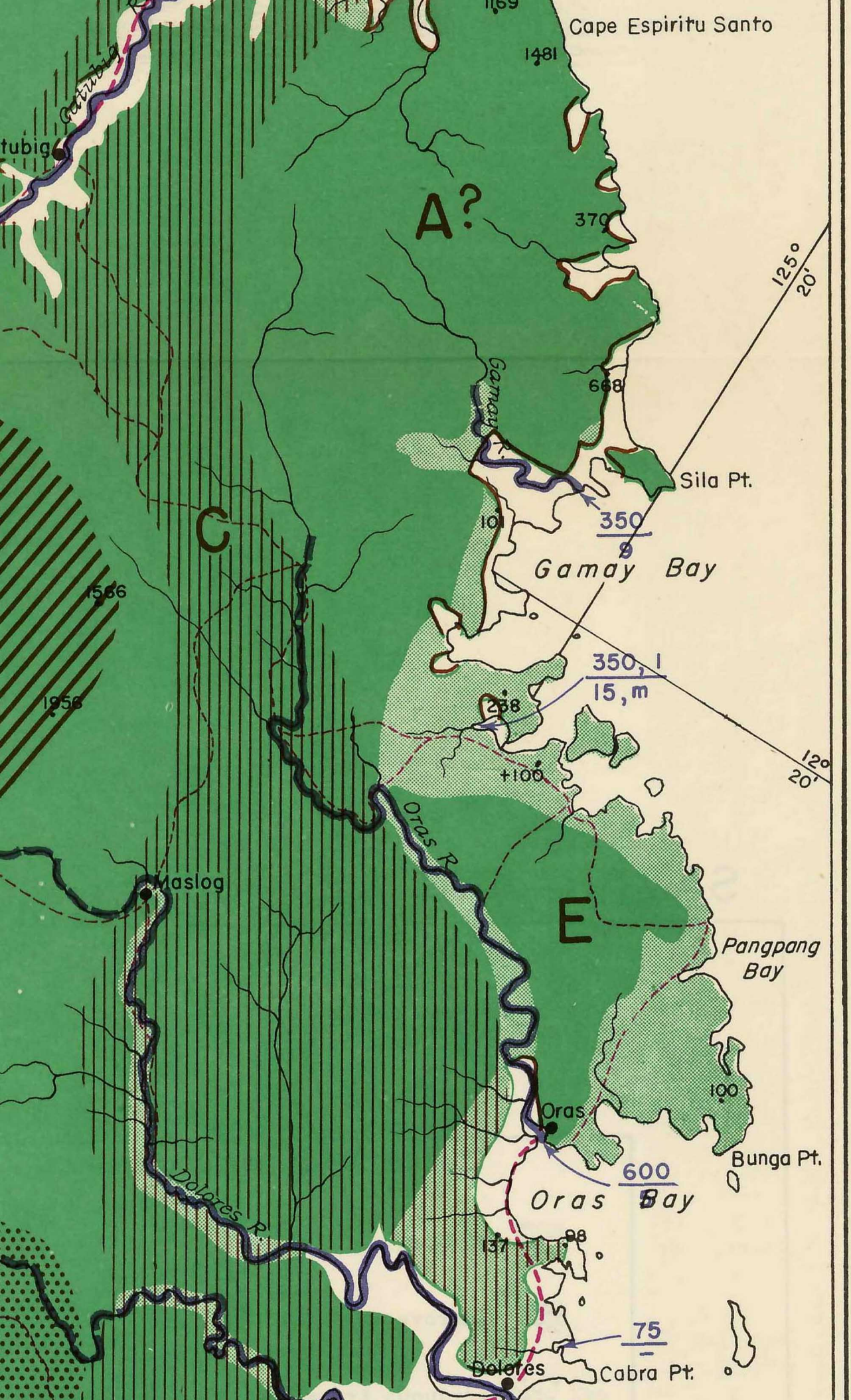
High hills and mountains: many deep narrow steep-sided valleys and steep-sloped knife-edge ridges, cliffs locally. In interior, slopes average about 30 percent, near coast are slightly gentler. Local relief generally over 250 feet. Alignments have many curves. Average grades generally need not be steep. Side-hill cuts necessary throughout area. Much bedrock is rotten, can be moved by bulldozers; in places hard rock requires blasting. For detailed data on ground conditions see Ground Conditions Explanation and patterns.

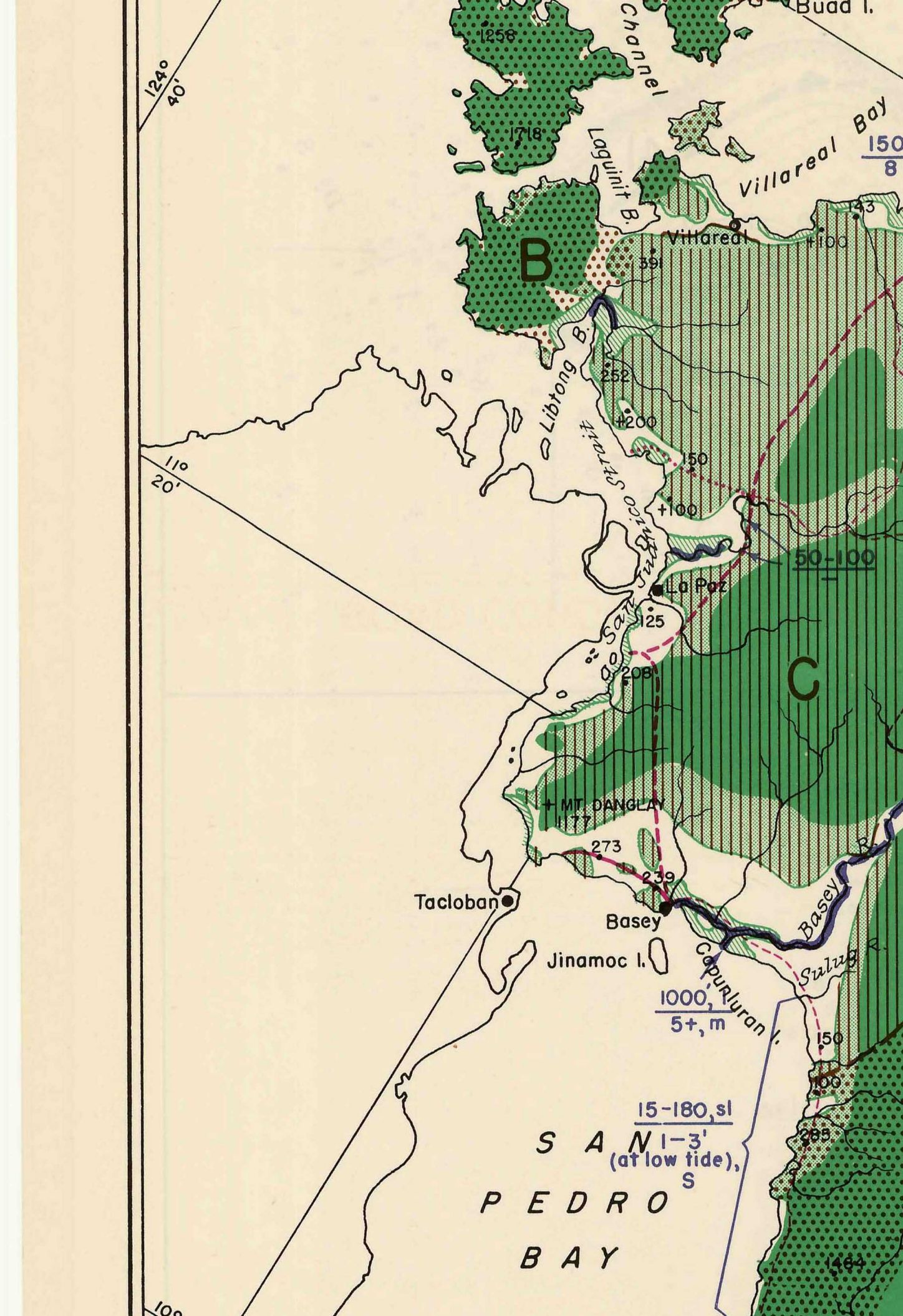
RELIABILITY: Good within 1 to 3 miles of coast.
Poor in interior.

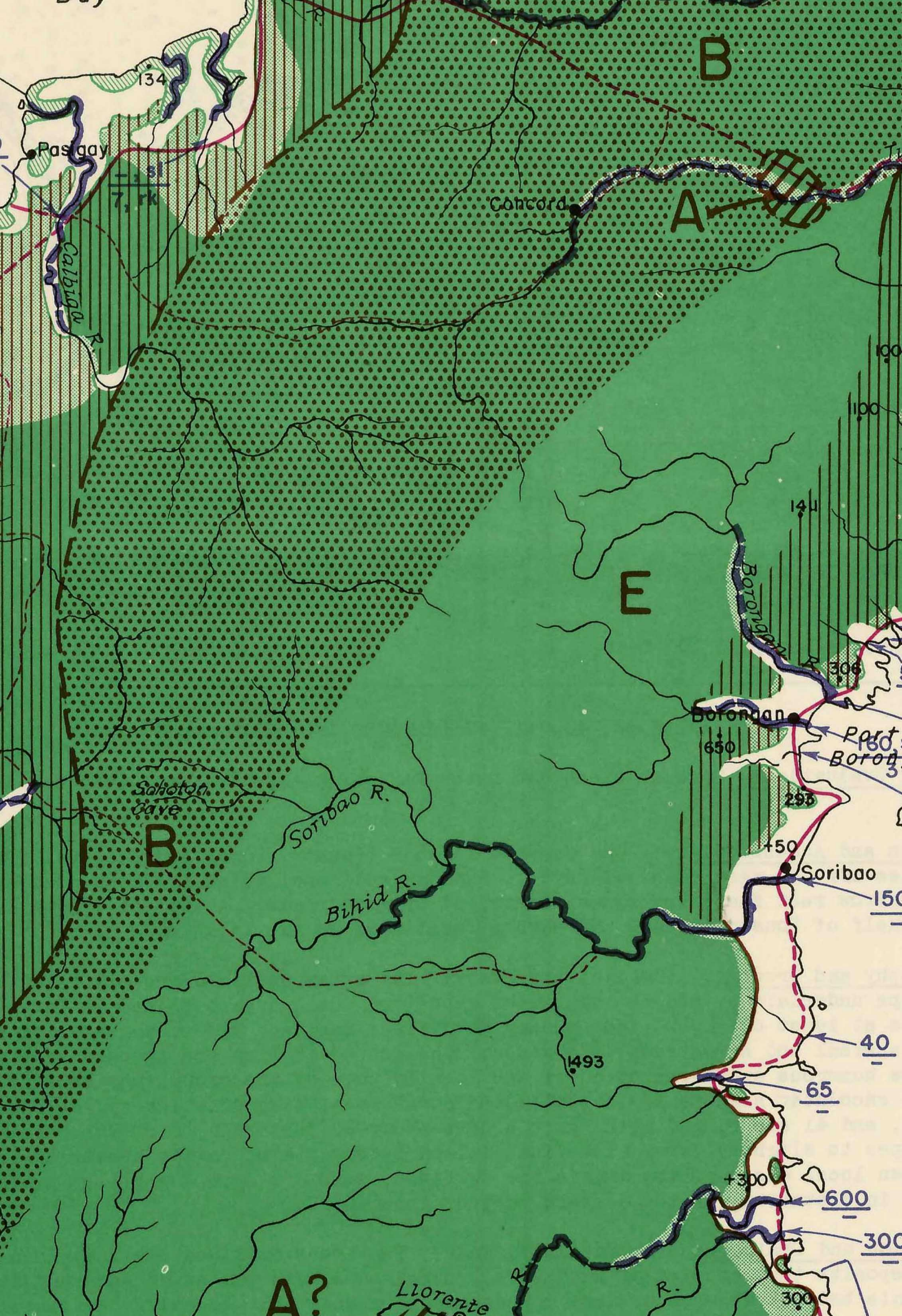


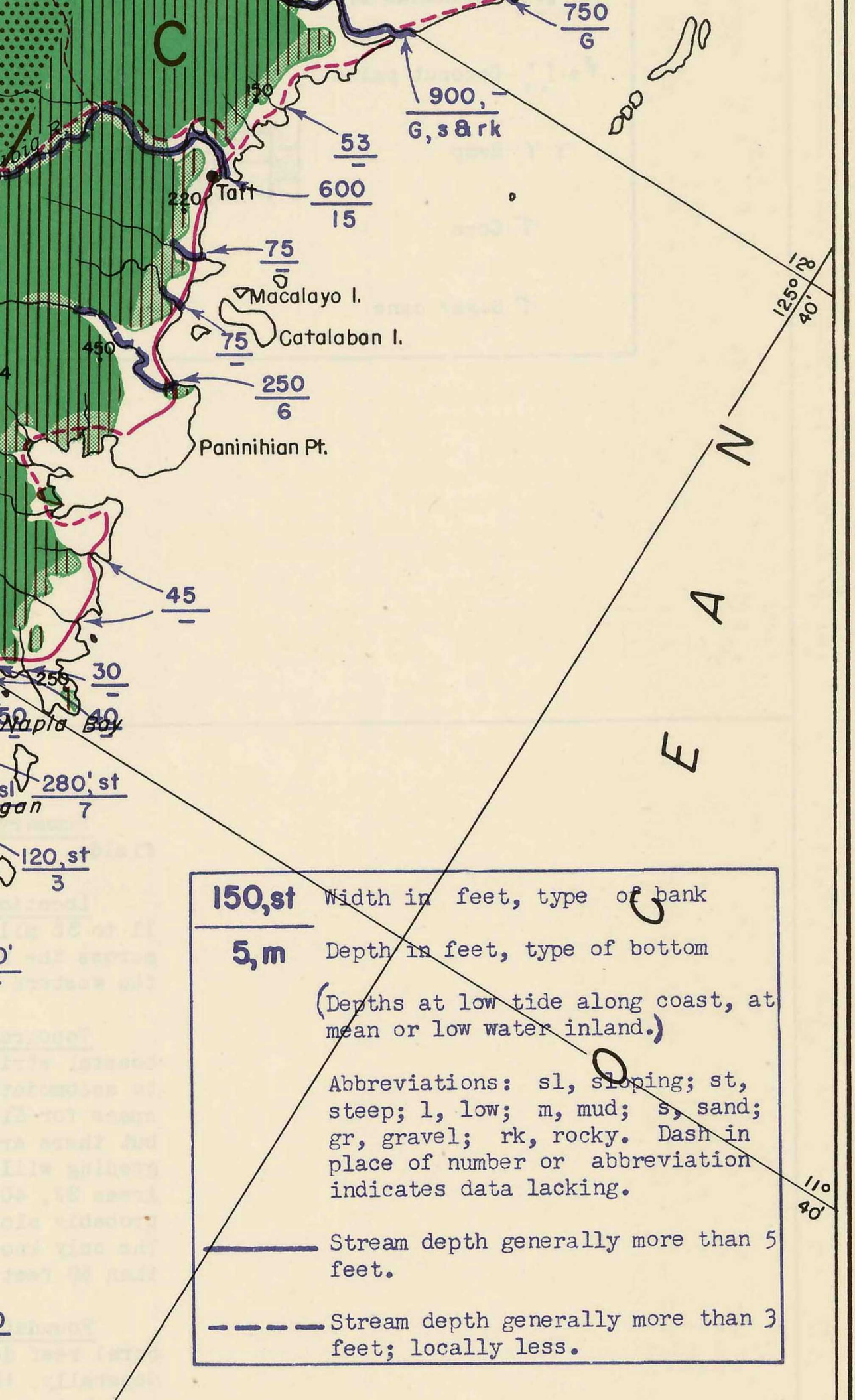

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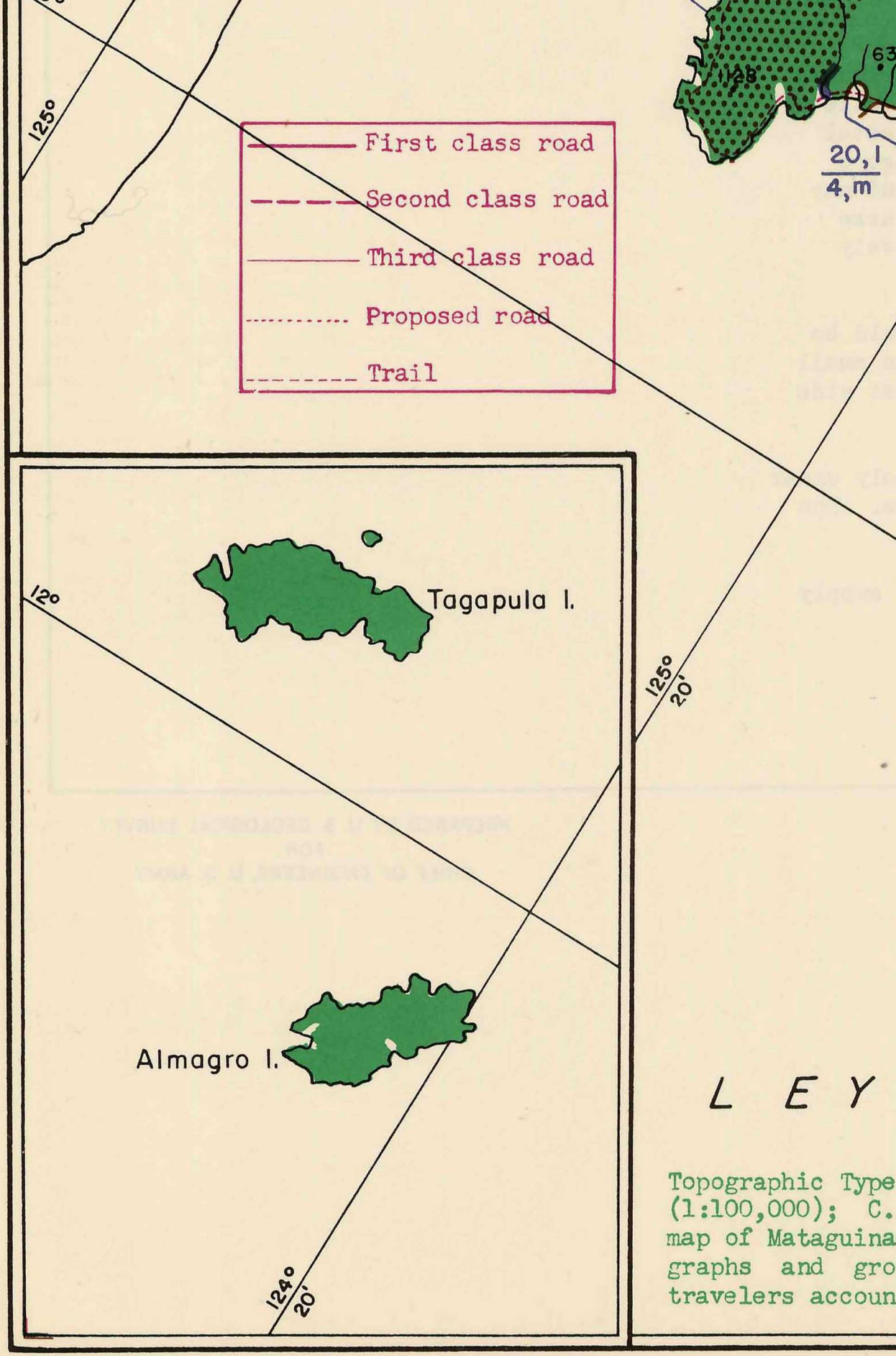

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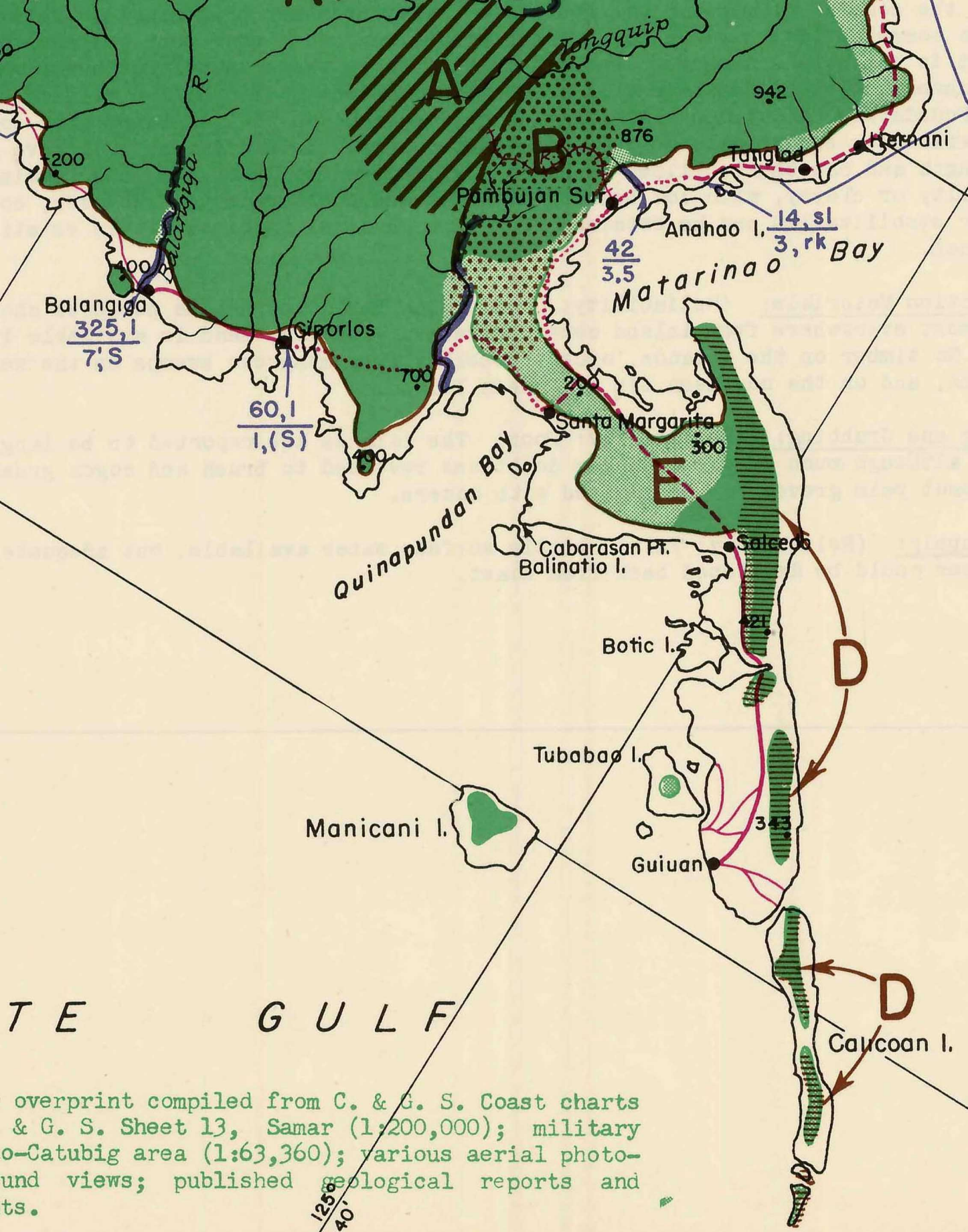

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150,st / 5,m	Width in feet, type of bank Depth in feet, type of bottom
	(Depths at low tide along coast, at mean or low water inland.)
	Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.
———	Stream depth generally more than 5 feet.
- - - -	Stream depth generally more than 3 feet; locally less.



Topographic Type
(1:100,000); C.
map of Mataguina
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Probably narrow, shallow streams, sand or gravel bottoms, sloping banks

GROUND CONDITIONS EXPLANATION

Patterns and large letters refer to ground conditions in LOW HILLS and HIGH HILLS AND MOUNTAINS as described in Map Units in table.

A Soils variable, generally clayey, poor foundations and subgrades. Soft and easily excavated and graded. Soils are thick to thin over bedrock. Bedrock hard, and where encountered in excavation requires blasting. Trap rock excellent for crushed stone, aggregate, and rip-rap.

B Soils highly variable, mostly sandy clay. Good foundation, fair to poor subgrade on gentler slopes, fair to poor foundations and subgrades on steeper. Weathered rock in some deep cuts makes good subgrade. Minor blasting necessary. Locally clay soils thin over shale, poor foundations and subgrades, strong tendency to slide, little or no blasting. Some of more rugged ridges, underlain by limestone, may require extensive rock blasting in grading; soils clayey, fair to poor foundations, poor subgrade.

C Sandy clay to clay soils, good to fair foundations, good to poor subgrades. Fewer very steep slopes than Unit B. Little or no blasting necessary. Some poorly consolidated sandstones and conglomerates may be usable as sand and gravel.

D Rocky coral limestone ridges, cliffs, thin clay soil over hard bedrock that requires blasting. Most of area readily by-passed.

5 0 5 10 15 Km

5 0 5 10 Miles

E Conditions unknown.

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Reliability: Fair

INTRODUCTION

Topography

A large mountain range, difficult to cross with roads forms backbone of Leyte Island; extensions are found in Biliran and Panson Islands. Broad coastal plain, favorable for road construction in northeast part of island separates east flank of main range from a small isolated mountain range in northeast corner. Narrower belt of coastal plains and low hills separates the central range from highlands of northwest peninsula. Scattered along the coast are flat or gently sloping plains, from a few hundred feet to 30 miles long and a few hundred feet to about five miles wide. They provide moderately easy routes for coastal roads. Small coastal flats are most extensive on west coast, on southwest coast of northwest peninsula, and the northeast corner of island. Almost no coastal flats on northeast coast of northwest peninsula, east side of Sogod Bay, and parts of southeast coast. Small swampy areas along coast are local obstacles, but generally can be easily by-passed.

Samar is a mountainous island, highest in the middle and northwestern parts. Altitude of highest peak 2,789 feet, relief generally less than 1,500 feet; intricate network of large and small ravines. Narrow fringe of small discontinuous coastal flats surround island. Some of larger river valleys, mostly on east and north coasts, have flat bottoms extending back many miles from coast. Small to large swampy areas along coast, particularly in west and southwest parts.

Existing Roads

So far as known there are no provincial roads with bituminous or concrete surface. First class roads are all-weather waterbound macadam. Other roads are stabilized or natural soil and passable or passable with difficulty in wet weather. Mountain roads require constant maintenance of surface, subgrade, and foundations, because of slides, erosion, and floods; roads on plains generally require only surface maintenance.

Locations of principal roads as recorded to 1941 are shown on the maps. The National Development Co. Petroleum Survey map of the northwestern peninsula of Leyte, included with this report, shows the Palompon-Cananga Road in a different position from other maps, which are based largely on Philippine Government maps.

Vegetation

The plains and lower mountain slopes of Samar and Leyte are largely open and cultivated. Larger valleys on Samar are locally cultivated. Mountainous areas, except for the grassy mountains at the north end of the northwestern peninsula of Leyte and on the Daram Islands are heavily wooded.

Possible Routes

Additional roads can be built practically anywhere in the large coastal-plains areas, if ground conditions are favorable and stream crossings not too difficult. Most desirable locations from viewpoin' of better foundations and easiest stream crossings are at upper edge of large alluvial plains.

Freedom of choice of alignment is very restricted in building coastal roads, and stream crossings may be difficult and longer than elsewhere. Along most of the coasts of Samar and Leyte, however, there is a narrow area behind the beach that can be used for a road with a minimum of grading and gentle grades.

Intercoastal mountain routes on Leyte, other than those already constructed, that appear from topography to offer the best opportunity for utilizing relatively low passes, are (1) east from Bato, (2) Sogod Bay north to Baybay-Abuyog road, (proposed location, BPW) (3) west from Borauen up Marabang River valley, (4) Dolores east to Lake Danao and down Binahaan River, and (5) Naval to Calbiran (Biliran Island), (a proposed road, BPW).

Intercoastal mountain routes on Samar may be feasible in the following places: (1) Up Basey River to headwaters of Soribao River, descending to mouth of Soribao near Borongan; (2) across divide between Gandara and Dolores River drainages; (3) Gandara to headwaters of Pambujan or Catubig Rivers. Part of course of upper Catubig is underground. All would be difficult to construct, and the specific nature of obstacles that would be encountered is not known. The Gandara-Dolores route would probably have best alignments and grades, Gandara-Catubig the worst.

Construction Problems

Alignments and grades:

Inland plains roads: Relatively straight alignments and gentle grades. Present road locations largely determined by centers of population.

Coastal roads: Locations except for those in plains areas are controlled by stream crossings, swamps, and headlands. Alignments follow coastline, gentle grades possible except in few places where road must take to hill or mountain slopes to avoid sea cliffs or swamps.

Mountain roads: Alignments have many sharp curves; steep grades can generally be avoided only by large increases in mileage, although roads that climb steadily will probably be very long anyway because of tig sags into tributary valleys. Except in southern part of island, main mountain range of Leyte can probably be crossed with rising grades that have few, if any, intermediate descents. Grades on Samar need not be excessive. Typical mountain roads must be carried almost entirely by side-hill cuts, locally in cliffs or near cliffs, because most ridge crests are too sinuous, narrow, rocky, and locally steep to be suitable locations.

Ground conditions:

Inland plains roads: Poor to fair foundations, better near mountains and on small plains. Soils mostly too clayey for suitable subgrade, not suitable for wearing surface. Poor surface and internal drainage near coast, better near mountains. Small swamps near coast, particularly near river mouths.

Coastal roads: Along coastal plains, fair to good foundations of coral sand, probably partly cemented; fair to good subgrade, generally good surfacing material for moderate traffic. Well drained. Narrow strips behind beaches at foot of steep slopes commonly have more clayey soil, less suitable for subgrade; soil may be thin over stony or gravelly material.

Mountain roads: Deep, clayey soil and weathered bedrock, make poor foundations, commonly subject to slides on steep slopes. Fills generally must be supported on steeper slopes. Occasional rock outcrops, particularly on upper parts of slopes and along streams; require much blasting for side hill cuts. Ledges make good foundations except in shale areas. Active erosion and sliding of fresh cuts in soil. Surface soil generally unsuitable for subgrade material. Good drainage.

Stream crossings:

Inland plains roads: Main rivers broad and shallow except near coast. Gravel and sand bottoms. Steep banks 5 to 20 feet high of poorly consolidated material.

Coast roads: River mouths commonly subject to tidal influence. Channels wide and deep; many streams not fordable. Bottoms sandy, silty; locally gravelly near mountains. Low sloping banks at shore; higher, steeper inland.

Mountain roads: Streams in deep, steep-sided valleys, locally widening to enclose small flats. Channels of two types, commonly alternating: (1) broad, shallow, with gravel bottoms, steep rock or gravel banks, and (2) narrow, deep, with rocky bottoms and high, steep or cliffed banks. Ford sites can generally be found.

Construction materials:

Timber: Coconut palms abundant along coast and in cultivated areas; heavy timber almost entirely confied to mountains. (See vegetation sheet).

Sand and gravel: Coral beach and dune sand along coast adjacent to large coastal plains. Varying porportions of gravel mixed with volcanic and coral sand in beach areas adjacent to hills or mountains. Sand mixed with silt and some gravel in lower parts of coastal plain stream channels; gravel and boulders increase in proportion and size towards mountains. Gravel and sand coarse and pockety in mountains. For use as concrete aggregate, material from stream beds generally requires washing to remove silt and clay. Probably some partly disintegrated sand and gravel below soil in inland parts of large coastal plains of Leyte.

Crushed stone and riprap: Hard bedrock, which can be crushed to make good road metal, is scarce in most parts of Samar, but fairly abundant in Leyte (see construction materials sheets). Boulders in mountain streams and upper coastal-plain streams suitable for crushed rock and riprap. Quarries in poor quality broken shale and serpentine near Palo and Tanauan. Quarry, probably in limestone near Catbalogan. Fair grades of trap rock obtainable for road metal or riprap through most of main mountain range of Leyte, and locally in Samar. Hard limestone in northeast corner of Leyte, in southern part of northwestern peninsula of Leyte and many inland points and on the southeast tip of Samar.

SAMAR

Map Unit	Topography	Alignments and Grades	Ground Conditions[a]	Stream Crossings	Construction Materials Available[b]
SWAMPS	Mangrove and nipa swamp; obstacles to construction of coastal roads. Fringes over 70 percent of coast between Wright and south end of San Juanico Strait, and extends over a mile inland along many rivers. Also fringes most of coast between Balicuatro Point and Bobon, for 30 miles north from Oras Bay, and shores of Matarinao Bay, also about 30 percent of coast between Oras and Matarinao Bays,and of the east half of the south coast. Unit includes two areas of grassy marsh just north and east of Calbayog.	No topographic limitations, alignments controlled by ground conditions. In large swampy areas and places where roads cross small swampy areas, alignments straight, grades flat. In the southern two thirds of Samar, behind most swamps are flat or gently sloping lowlands; generally unnecessary to cross much swamp in road locations. On east coast, north of Dolores River, and at west end of north coast, many hills rise directly from coastal swamps, and hill or mountain roads are alternative to a coastal road with many swampy stretches.	Peat and muck to shallow depth over plastic clay. In smaller coastal swamps may be firm ground below clay at depths of several feet. Silt and mud may be very deep in large swamps at river mouths. Unsuitable for road foundations. Not drained; coastal swamps covered by 3 to 4 feet of water at high tide.	Larger streams generally wide and deep; banks low or submerged; bottoms muddy. Depths of streams shown on map refer to depth at low tide in coastal areas. In areas of coastal swamps, smaller streams may empty into wide, deep tidal channels.	Mangrove wood available in coastal swamps. Gravel and stone not available within swampy areas, beach sand locally available at seaward edges of or adjacent to swamps.
LOWLANDS	Unit includes (1) large and small flat or gently sloping areas between shoreline and hills or mountains, and (2) alluvial lowlands of large river valleys. Coastal flats may be as much as 50 feet above sea level, as on parts of the east coast of Samar where they are separated from the beach by high bluffs, and in places includes low hills.	Alignments can be fairly straight, grades flat within limits of coastal flats and stream valleys. Locally rivers may be present at foot of steep slopes in large valleys; in these places river crossings or hill-side road locations necessary.	Coastal flats: On the eastern part of south and north coasts and on the east coast seaward margins of coastal flats underlain mostly by coral sand, commonly slightly cemented; on north coast dunes lie behind some beaches. Fair to good foundation and subgrade material. Unsatisfactory wearing surface under heavy traffic as sand grains are readily pulverized. Well drained. Clearing involves mostly coconut palms. Most coastal flats, excluding some sandy margins where present, made up of silt with minor sand and gravel. Soil over silt consists of 8 to 15 inches of silty loam over 2 to 3 feet of clay. Poor to fair foundations, not suitable for use directly beneath wearing surface. Some addition of sandy material required for stabilization; may be possible locally to produce stabilized soil by mixing soil with underlying sands. Fair internal drainage, poor in rice areas. Flats commonly under cultivation. Coconuts are principal trees, minor clearing necessary. Some grading of unconsolidated material necessary to raise road above poorly drained areas, particularly rice fields. Some side-hill cuts may be necessary where slopes locally reach grades of 10 percent. Probably little or no blasting. Valley lowlands: Irregular mixtures of silt, sand, and gravel along larger rivers. Sandy natural levees close to stream channels. Lower flat areas, where present between natural levee and valley wall, contain thin silt and clay soil over sand, gravel and silt; locally marshy. Flats along smaller streams with steeper gradients generally sandy with thin silty topsoil. Poor to good foundations and subgrades. Where topsoil is silt or clay, it can be mixed locally with underlying coarser material to form stable soil. Good drainage on valley slopes with natural levees, poor in intervening low areas. Floods may inundate lowland areas and may cause stream channels to shift suddenly. Grading in unconsolidated material may be needed locally for drainage. Little clearing needed, some bamboo thickets near villages.	Coastal flats: Larger rivers too deep to be fordable; commonly 150 to 900 feet wide at mouths, 6 to 15 feet deep. Bar across entrance to some rivers; depth of water as little as 3 feet at low tide. Sloping or steep silty banks, generally low on west, low to about 20 feet high along parts of east coast. Larger rivers and most smaller rivers much deeper and wider near coast than farther upstream. Bottoms sandy and gravelly. Valley lowlands: Streams wide and deep, banks probably average at least 10 feet above low water level, fairly steep on outside of curves, gently sloping on inside. Bottoms sandy, more gravelly upstream.	Coconut palms along coast furnish some timber; bamboo common along inland river valleys. Some calcareous sand available from beaches and dunes on northeast, east, and southeast coasts and near Calbayog on west coast. Large workable deposits of gravel and sand probably scarce in lowlands, but may be present in valleys in adjacent hilly and mountain areas. (See Unit 4, Mountains). Generally no hard rock suitable for crushing or riprap is exposed within unit.
LOW HILLS	Hilly country with moderate to steep slopes; few cliffs. Local relief generally less than 250 feet. Generally adjacent to higher country. Slopes in upper parts of some large rivers may be gentler than average for region, and such areas are included with low Hills. Boundaries between units 3 and 4 generally diagrammatic.	Roads will have many curves. Side-hill cuts necessary almost everywhere. Grades need not be excessive as control points do not have large difference of elevation. Detours and alternate routes generally possible.	Similar to mountains (Unit 4) Rock ledges less common, depth of bedrock generally greater than in mountains; less blasting necessary, less danger of slides.	Most streams small, shallow, and rocky. Can be forded by motorized traffic at many points.	Same as in high hills and mountains (see Unit 4, below).
HIGH HILLS AND MOUNTAINS	Low rugged mountains cover most of island, maximum altitude 2,789 feet. Mountains and ridge tops generally 500 to 1,500 feet above nearby stream valleys; very few prominent peaks. Some higher areas in north central part of island have 1,500 to 2,000 feet of relief. Valleys deep, narrow, and V-shaped. Streams very crooked, with many small tributary ravines. Average grade of slopes in interior about 30 percent; some cliffs and very steep slopes; generally steepest near top. Many very sinuous knife-edge ridges between valleys and ravines. In northwest Samar, relief near coast, is similar to that of inland areas. Near coast highest mountains are in northwest and northeast corners of island (1,500 to 2,000 feet). Slopes near northwest coast have grades of 30 percent or more; elsewhere near coast average is about 25 percent.. In some areas near east coast, country is less rugged, more rolling; average slopes may be only 20 percent, although parts of most slopes are much steeper.	Valley and mountainside locations generally perferable. Most ridge tops too narrow, winding, irregular in height, to use for more than short distances. Alignments will have many sharp curves to conform to slopes; slopes cut by many small gullies. Slopes generally too high and steep, gullies too deep to permit much reduction of curvature by cut and fill. Side-hill cuts throughout most locations; some cuts may be in rock cliffs. Grades can generally be kept low because unavoidable curves give more than adequate length for the relatively low total climbs. Few available detours. Near coast, particularly on east side of island, gentler slopes permit freer use of cut and fill, gentle climbs reduce number of sharp curves. Winding roads, however, are unavoidable (see Terrain Views 3 and 4). Any coastal roads in the following places must be built on steep mountain slopes for appreciable parts of their distance: Calbayog to northwest tip of island, and east for 15 miles; east side of San Pedro Bay; Samar Bay to northeast tip of Samar, and any routes built on Daram Island or the peninsula south of it. Present road north from Catbalogan is of this type. Such locations differ from typical mountain locations only in that it is generally unnecessary to gain much altitude.	Mountain areas[a] are subdivided according to different types of bedrock and soil. General ground conditions throughout mountain areas, due largely to slope, vary only in degree with different bedrock and soil types. Soils are generally clayey, fair to poor foundations, poor subgrades, except for much of soil in Unit B, which is sandy clay soil, good to fair foundation, fair to poor subgrade. Some of weathered rock below topsoil in Units A and B may make good subgrade. Steep slopes require continuous side-hill cuts. Fills will not catch on steeper slopes and road foundation must be supported mostly, if not wholly, in cuts or by artificial supports. On very steep slopes in unconsolidated materials, particularly in shale areas (in Units B and D) foundations may slide locally in wet weather, and high cut banks are almost certain to slide for many years until equilibrium is reached. Particularly on steeper slopes in Units A, B, and D, some cuts will be in rocks that require blasting. Bedrock is probably most abundant in and just above channels of smaller mountain streams. Surface drainage is good, internal drainage generally fair to poor. Drainage ditches and road surface must be designed to withstand severe erosion during heavy rains. Large culverts essential. Much heavy timber to clear everywhere. Limited areas of cogon grass near coasts. Small flats along larger streams in mountain areas may locally have characteristics described under alluvial lowlands (Unit 2).	Streams flow in narrow, winding, steep-walled valleys. Two principal types of channel in different parts of same streams: (1) broad, shallow, with gravel and boulder bottoms, steep rocky or gravel banks; (2) narrow and deep with rocky bottoms, waterfalls; and steep-cliffed walls. Large rivers in Samar probably have deeper, slower water, more bedrock gorges than those on Leyte. Occasional flash floods, particularly in winter. Extremes under cutting of banks, fills, and abutments during floods.	Timber abundant. Probably only small pockets of sand and gravel available in stream channels of mountains. Benches and high banks of streams in flatter parts of stream courses may contain good gravel and sand, particularly in areas of Unit A and B and their environs. Pebbles and boulders in these areas may be largely hard limestone and trap rock. Beaches adjacent to mountain areas may contain coral sand, and some gravel with hard, well rounded pebbles and cobbles. There are several gravel deposits along the road between Catbalogan and Loquilocon; they are probably in the poorly consolidated sandstones and pebble conglomerates of Unit C, and suggest that similar deposits may be found elsewhere in Unit C. Sand and gravel, probably with low crushing strength, may be obtainable from weathered outcrops of sandstone and conglomerate in Unit B, but such deposits have very limited extent. Traprock and hard limestone may be found in Units A, B, and D. Other bedrock in these areas may be satisfactory for use as riprap or crushed rock. There is road metal quarry near the main highway two or three miles north of Catbalogan; stone probably is hard limestone.

[a] For more detailed information on ground conditions, see Ground Conditions Explanation and patterns (Units A,B,C,D,E,F) on map.

[b] See also Construction Materials Sheet.

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE (P.I.)

Topography

A large mountain range, difficult to cross with roads forms backbone of Leyte Island; extensions are found in Biliran and Panaon Islands. Broad coastal plain, favorable for road construction in northeast part of island separates east flank of main range from a small isolated mountain range in northeast corner. Narrower belt of coastal plains and low hills separates the central range from highlands of northwest peninsula. Scattered along the coast are flat or gently sloping plains, from a few hundred feet to 30 miles long and a few hundred feet to about five miles wide. They provide moderately easy routes for coastal roads. Small coastal flats are most extensive on west coast, on southwest coast of northwest peninsula, and the northeast corner of island. Almost no coastal flats on northeast coast of northwest peninsula, east side of Sogod Bay, and parts of southeast coast. Small swampy areas along coast are local obstacles, but generally can be easily by-passed.

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ger rivers too deep to be fordable; feet wide at mouths, 6 to 15 feet ntrance to some rivers; depth of water at low tide. Sloping or steep silty w on west, low to about 20 feet high coast. Larger rivers and most smaller and wider near coast than farther up- ndy and gravelly. reams wide and deep, banks probably feet above low water level, fairly curves, gently sloping on inside. gravelly upstream. ll cuts may be necessary atural levees close to ntain thin silt and eper gradients psoil is silt or rainage on valley as and may cause y for drainage.	Coconut palms along coast furnish some timber; bamboo common along inland river valleys. Some calcareous sand available from beaches and dunes on northeast, east, and southeast coasts and near Calbayog on west coast. Large workable deposits of gravel and sand probably scarce in lowlands, but may be present in valleys in adjacent hilly and mountain areas. (See Unit 4, Mountains). Generally no hard rock suitable for crushing or riprap is exposed within unit.
shallow, and rocky. Can be forded c at many points.	Same as in high hills and mountains (see Unit 4, below).

	included with low hills. Boundaries between units 3 and 4 generally diagrammatic.	
HIGH HILLS AND MOUNTAINS	Low rugged mountains cover most of island, maximum altitude 2,789 feet. Mountains and ridge tops generally 500 to 1,500 feet above nearby stream valleys; very few prominent peaks. Some higher areas in north central part of island have 1,500 to 2,000 feet of relief. Valleys deep, narrow, and V-shaped. Streams very crooked, with many small tributary ravines. Average grade of slopes in interior about 30 percent; some cliffs and very steep slopes; generally steepest near top. Many very sinuous knife-edge ridges between valleys and ravines. In northwest Samar, relief near coast, is similar to that of inland areas. Near coast highest mountains are in northwest and northeast corners of island (1,500 to 2,000 feet). Slopes near northwest coast have grades of 30 percent or more; elsewhere near coast average is about 25 percent.. In some areas near east coast, country is less rugged, more rolling; average slopes may be only 20 percent, although parts of most slopes are much steeper.	Valley and mountainside locations general able. Most ridge tops too narrow, wind regular in height, to use for more than tances. Alignments will have many shar to conform to slopes; slopes cut by many gullies. Slopes generally too high and gullies too deep to permit much reducti curvature by cut and fill. Side-hill c out most locations; some cuts may be in Grades can generally be kept low becaus able curves give more than adequate len relatively low total climbs. Few avail Near coast, particularly on east side o gentler slopes permit freer use of cut gentle climbs reduce number of sharp cu ing roads, however, are unavoidable (se Views 3 and 4). Any coastal roads in the following plac built on steep mountain slopes for appr parts of their distance: Calbayog to n tip of island, and east for 15 miles; e San Pedro Bay; Gamay Bay to northeast t and any routes built on Daram Island or sula south of it. Present road north f gan is of this type. Such locations di typical mountain locations only in that generally unnecessary to gain much alti

lly perfer-
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tude.

Mountain areas[a] are subdivided according to different types of bedrock and soil. General ground conditions throughout mountain areas, due largely to slope, vary only in degree with different bedrock and soil types.

Soils are generally clayey, fair to poor foundations, poor subgrades, except for much of soil in Unit B, which is sandy clay soil, good to fair foundation, fair to poor subgrade. Some of weathered rock below topsoil in Units A and B may make good subgrade.

Steep slopes require continuous side-hill cuts. Fills will not catch on steeper slopes and road foundation must be supported mostly, if not wholly, in cuts or by artificial supports. On very steep slopes in unconsolidated materials, particularly in shale areas (in Units B and C), foundations may slide locally in wet weather, and high cut banks are almost certain to slide for many years until equilibrium is reached. Particularly on steeper slopes in Units A, B, and D, some cuts will be in rocks that require blasting. Bedrock is probably most abundant in and just above channels of smaller mountain streams. Surface drainage is good, internal drainage generally fair to poor. Drainage ditches and road surface must be designed to withstand severe erosion during heavy rains. Large culverts essential.

Much heavy timber to clear everywhere. Limited areas of cogon grass near coasts.

Small flats along larger streams in mountain areas may locally have characteristics described under alluvial lowlands (Unit 2).

Streams flow in nar
Two principal types
same streams: (1)
bottoms, steep rock
deep with rocky bot
walls. Large river
slower water, more
Occasional flash fl
under cutting of ba
floods.

[a] For more detailed information on ground conditions, see Ground Conditions Explanation and patterns (Units A,B,C,D,E,F) on map.
[b] See also Construction Materials Sheet.

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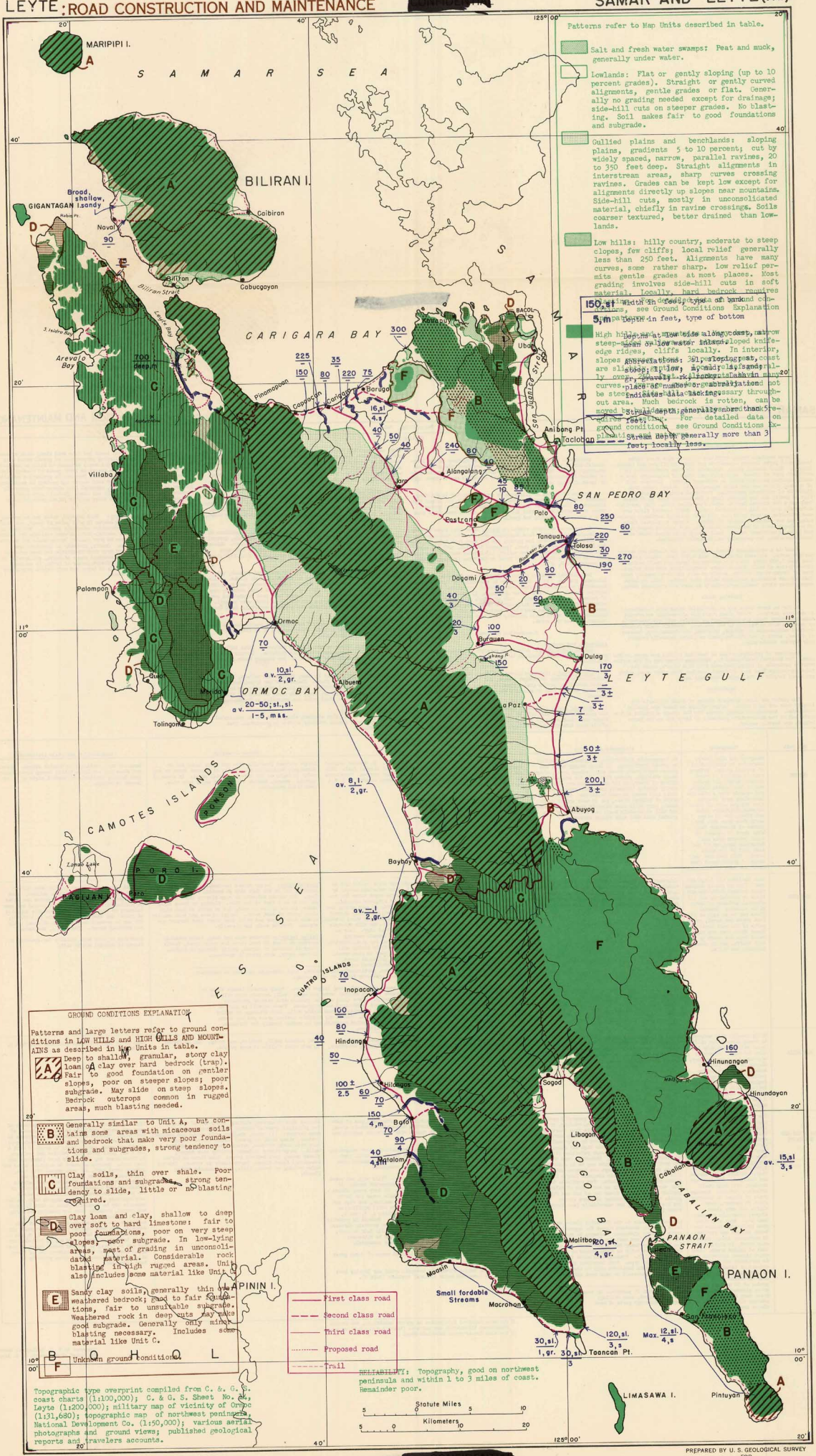
row, winding, steep-walled valleys. of channel in different parts of broad, shallow, with gravel and boulder y or gravel banks; (2) narrow and toms, waterfalls; and steep-cliffed s in Samar probably have deeper, bedrock gorges than those on Leyte. oods, particularly in winter. Extreme nks, fills, and abutments during	Timber abundant. Probably only small pockets of sand and gravel available in stream channels of mountains. Benches and high banks of streams in flatter parts of stream courses may contain good gravel and sand, particularly in areas of Unit A and B and their environs. Pebbles and boulders in these areas may be largely hard limestone and trap rock. Beaches adjacent to mountain areas may contain coral sand, and some gravel with hard, well rounded pebbles and cobbles. There are several gravel deposits along the road between Catbalogan and Loquilocon; they are probably in the poorly consolidated sandstones and pebble conglomerates of Unit C, and suggest that similar deposits may be found elsewhere in Unit C. Sand and gravel, probably with low crushing strength, may be obtainable from weathered outcrops of sandstone and conglomerate in Unit B, but such deposits have very limited extent. Traprock and hard limestone may be found in Units A, B, and D. Other bedrock in these areas may be satisfactory for use as riprap or crushed rock. There is road metal quarry near the main highway two or three miles north of Catbalogan; stone probably is hard limestone.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army.

LEYTE: ROAD CONSTRUCTION AND MAINTENANCE

[redacted]

SAMAR AND LEYTE (P.I.)



GROUND CONDITIONS EXPLANATION

Patterns and large letters refer to ground conditions in LOW HILLS and HIGH HILLS AND MOUNTAINS as described in Map Units in table.

A — Deep to shallow, granular, stony clay loam or clay over hard bedrock (trap). Fair to good foundation on gentler slopes, poor on steeper slopes; poor subgrade. May slide on steep slopes. Bedrock outcrops common in rugged areas, much blasting needed.

B — Generally similar to Unit A, but contains some areas with micaceous soils and bedrock that make very poor foundations and subgrades, strong tendency to slide.

C — Clay soils, thin over shale. Poor foundations and subgrades, strong tendency to slide, little or no blasting required.

D — Clay loam and clay, shallow to deep over soft to hard limestone: fair to poor foundations, poor on very steep slopes, poor subgrade. In low-lying areas, most of grading in unconsolidated material. Considerable rock blasting in high rugged areas. Unit also includes some material like Unit C.

E — Sandy clay soils, generally thin over weathered bedrock; good to fair foundations, fair to unsuitable subgrade. Weathered rock in deep cuts may make good subgrade. Generally only minor blasting necessary. Includes some material like Unit C.

F — Unknown ground conditions.

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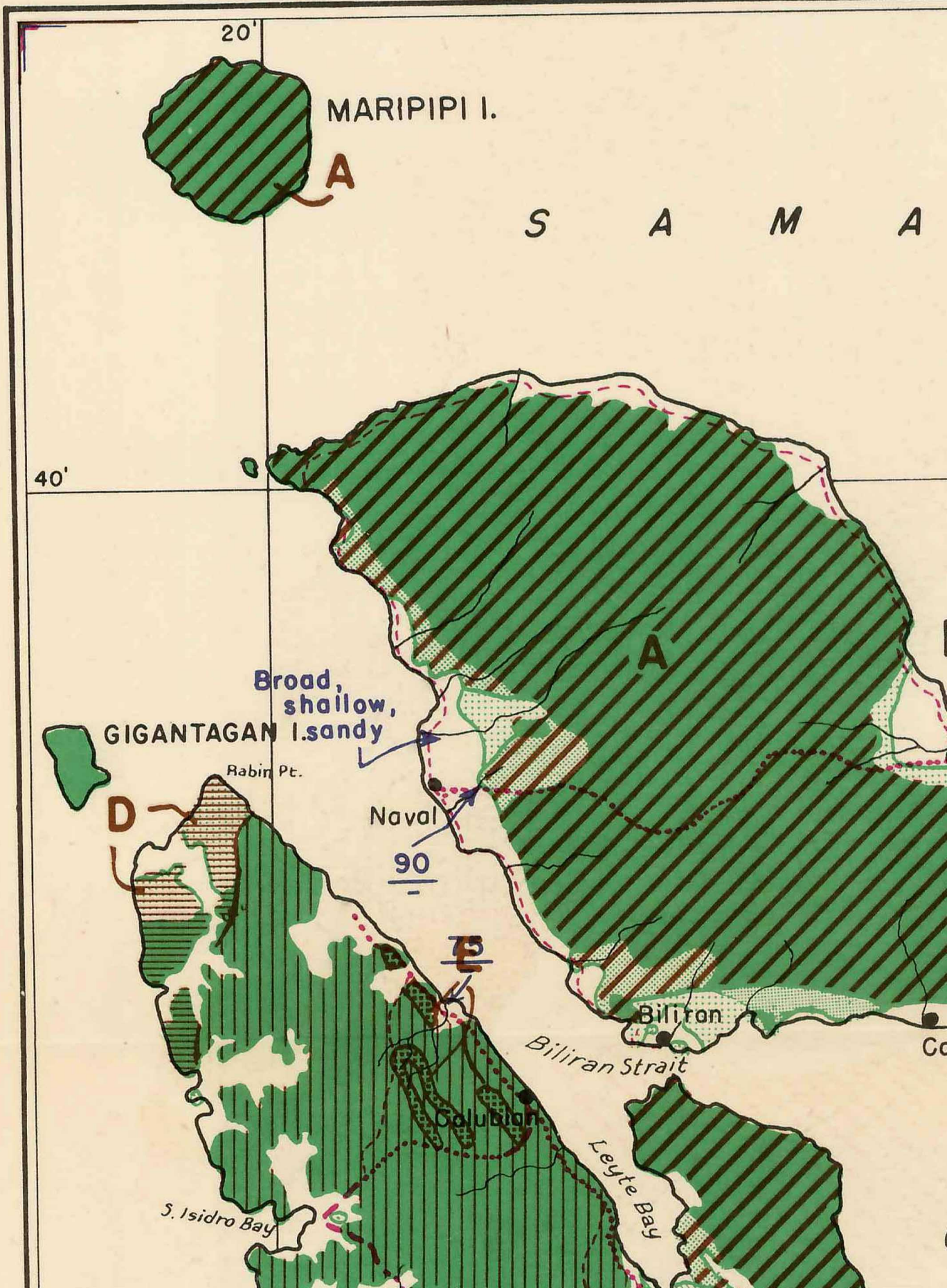
RELIABILITY: Topography, good on northwest peninsula and within 1 to 3 miles of coast. Remainder poor.

Topographic type overprint compiled from C. & G. S. coast charts (1:100,000); C. & G. S. Sheet No. 24, Leyte (1:200,000); military map of vicinity of Ormoc (1:31,680); topographic map of northwest peninsula, National Development Co. (1:50,000); various aerial photographs and ground views; published geological reports and travelers accounts.

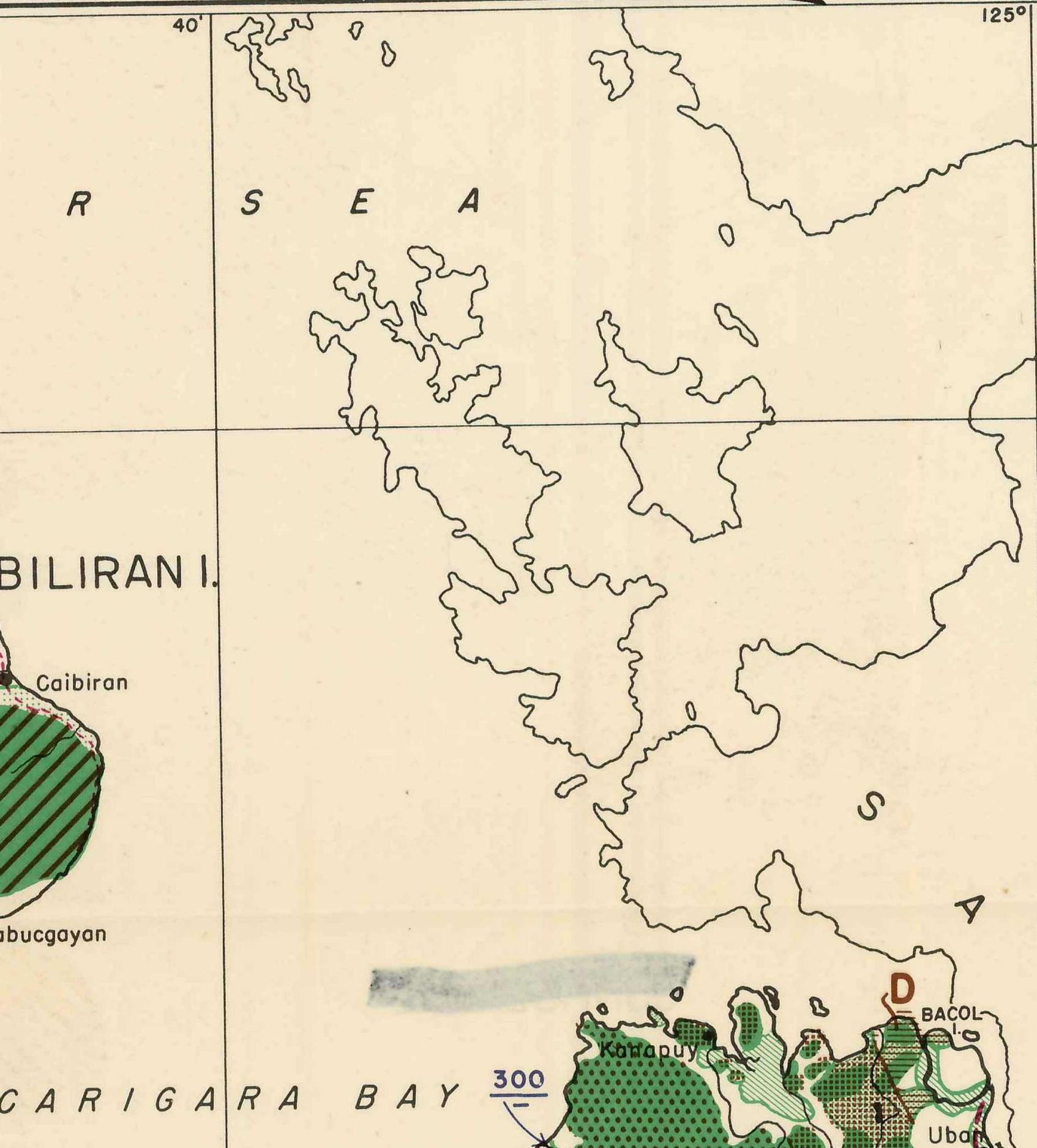
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Patterns refer to Map Units described in table.

Salt and fresh water swamps: Peat and muck, generally under water.

Lowlands: Flat or gently sloping (up to 10 percent grades). Straight or gently curved alignments, gentle grades or flat. Generally no grading needed except for drainage; side-hill cuts on steeper grades. No blasting. Soil makes fair to good foundations and subgrade.

40'

Gullied plains and benchlands: sloping plains, gradients 5 to 10 percent; cut by widely spaced, narrow, parallel ravines, 20 to 350 feet deep. Straight alignments in interstream areas, sharp curves crossing ravines. Grades can be kept low except for alignments directly up slopes near mountains. Side-hill cuts, mostly in unconsolidated material, chiefly in ravine crossings. Soils coarser textured, better drained than lowlands.

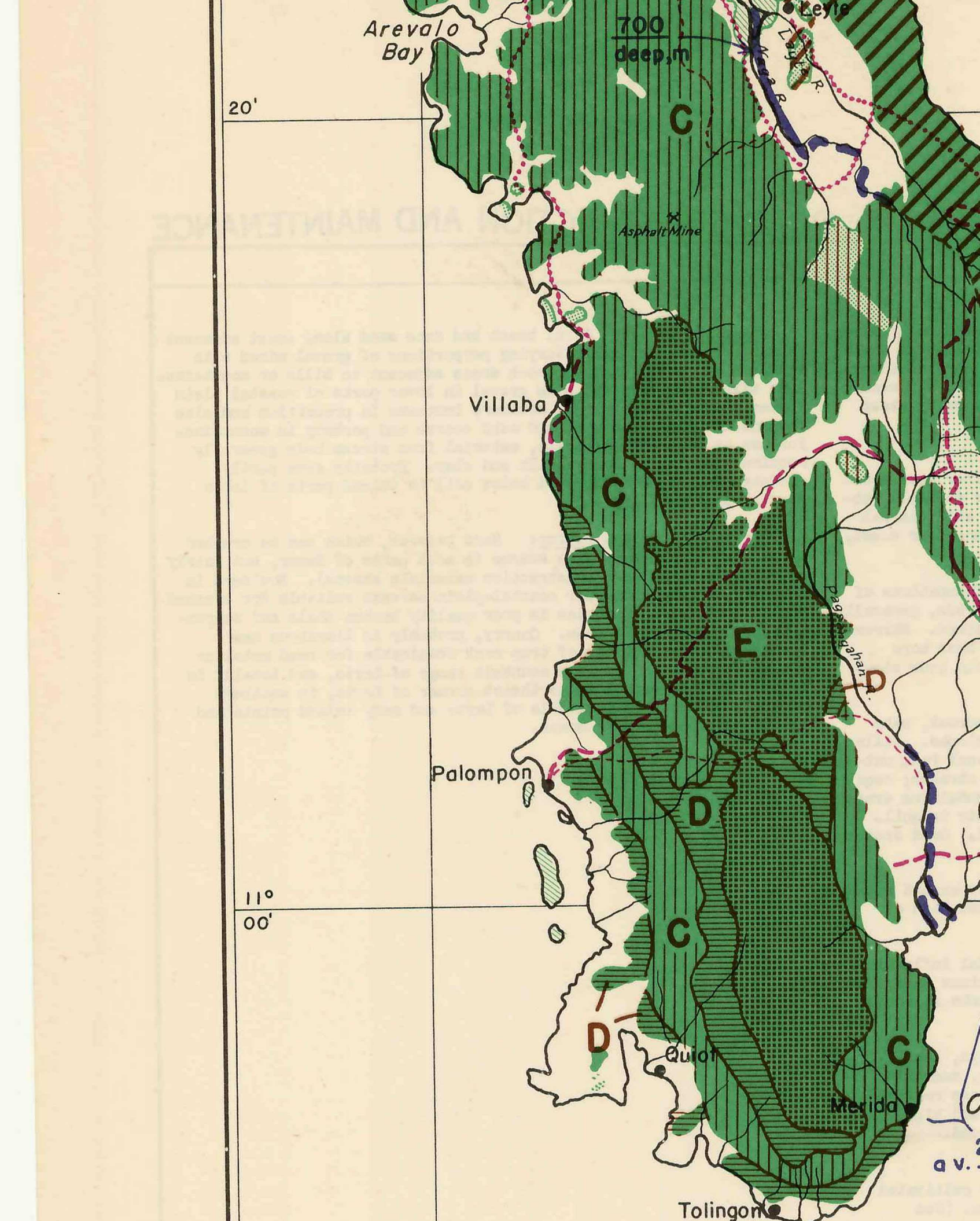
Low hills: hilly country, moderate to steep clopes, few cliffs; local relief generally less than 250 feet. Alignments have many curves, some rather sharp. Low relief permits gentle grades at most places. Most grading involves side-hill cuts in soft material. Locally, hard bedrock requires blasting. For detailed data on ground conditions, see Ground Conditions Explanation and patterns.

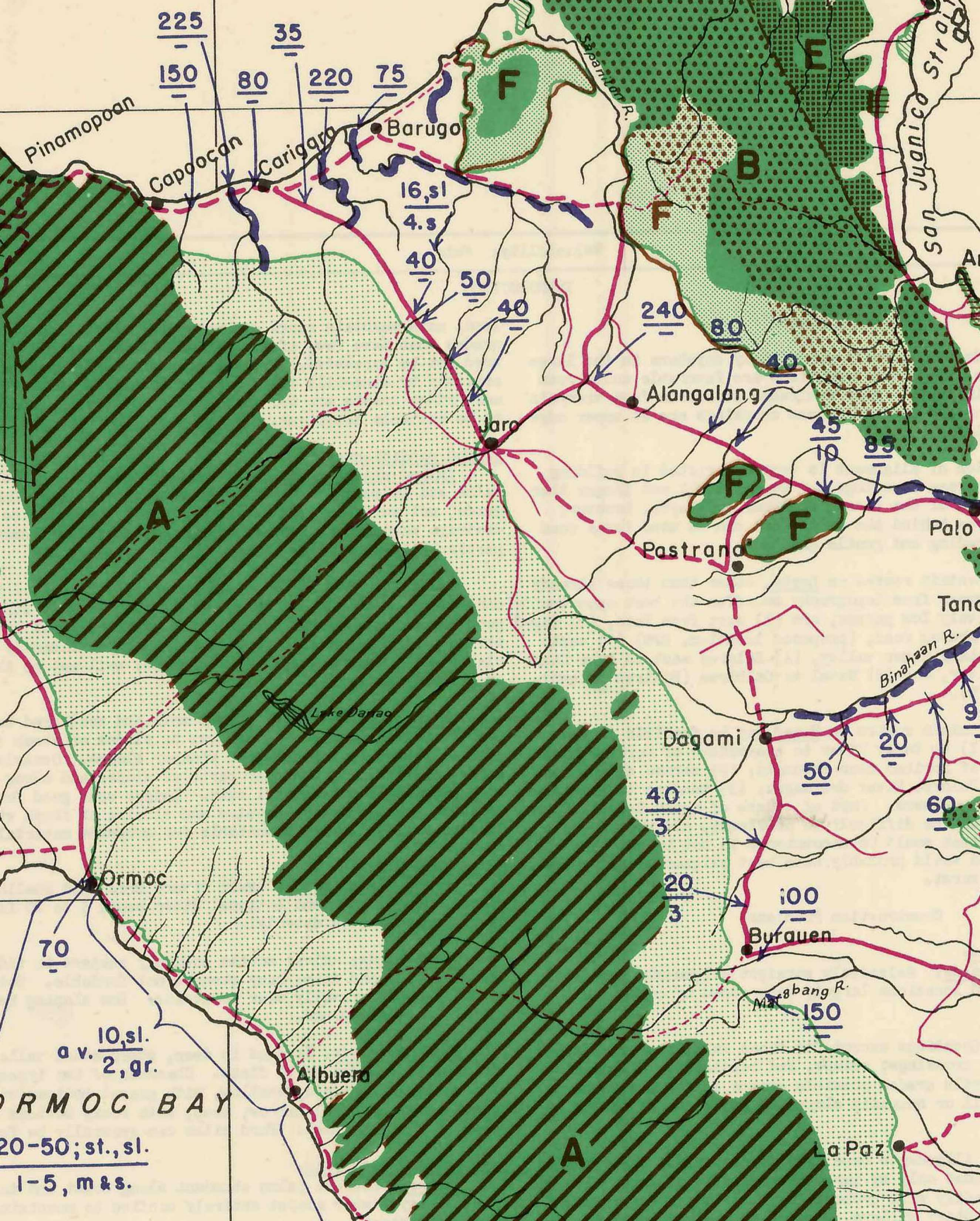
150, st — Width in feet, type of bank

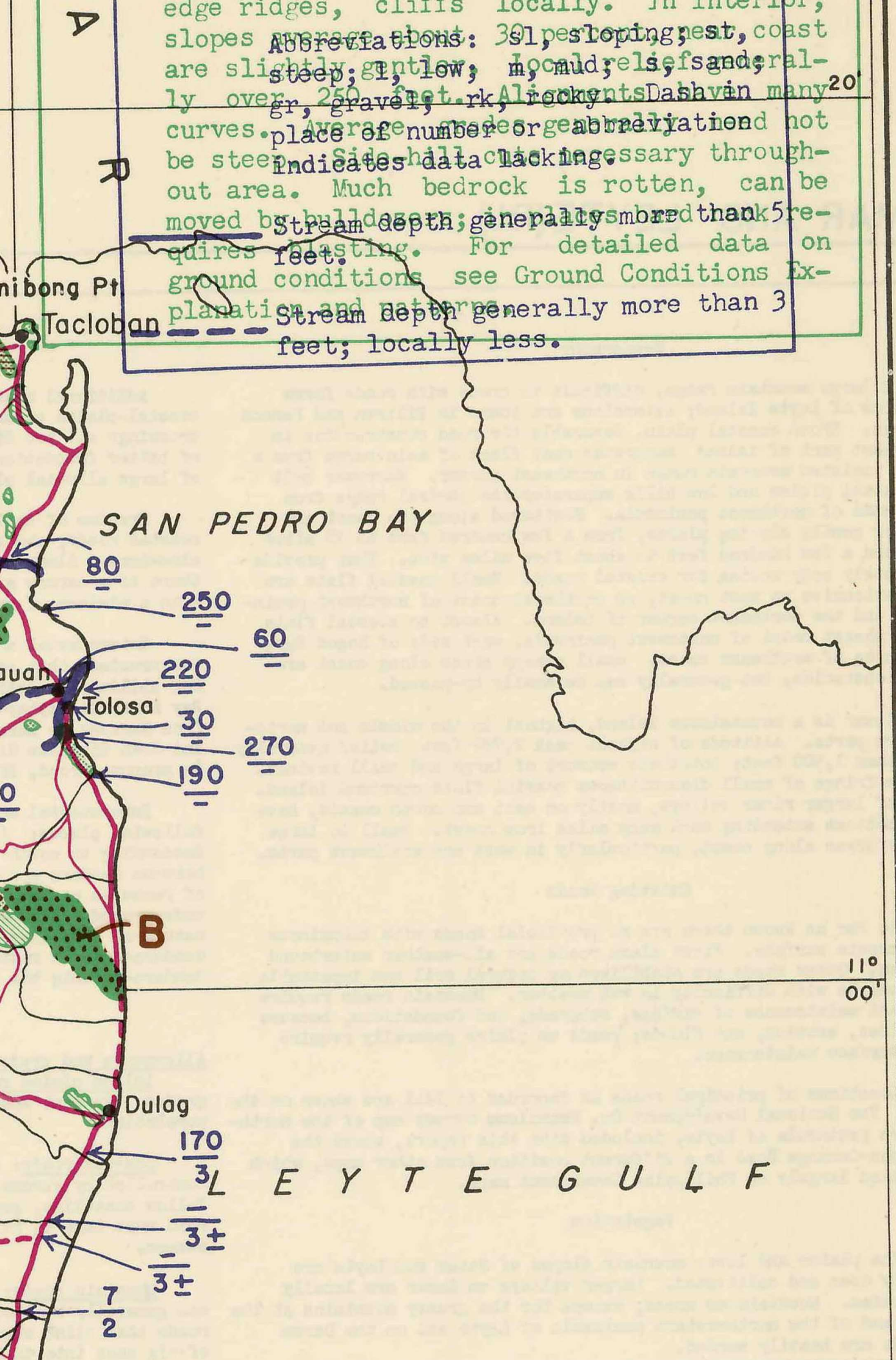
5, m — Depth in feet, type of bottom

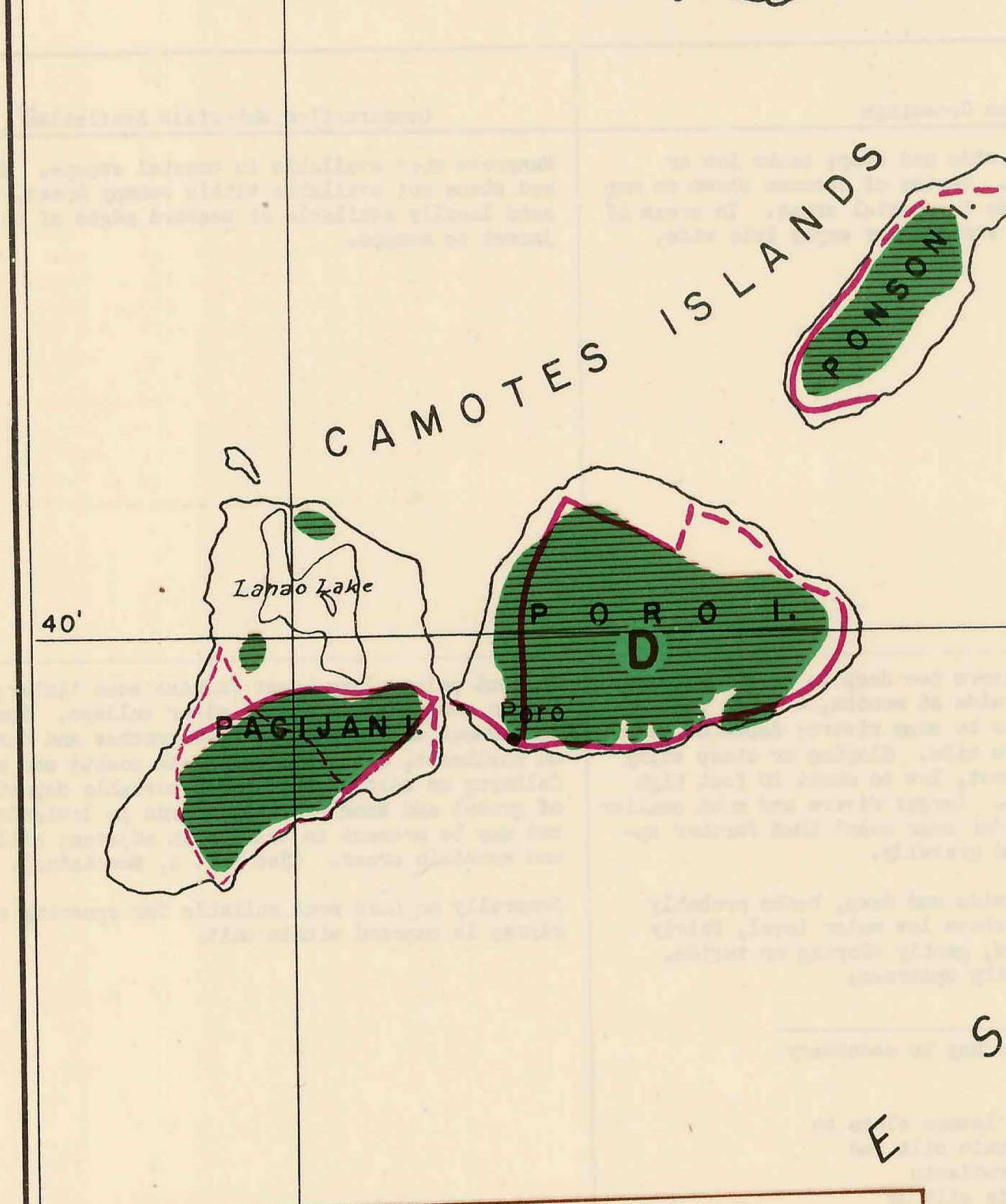
Depths at low tide along coast, at mean or low water inland.

High hills and mountains: Many deep, narrow steep-sided valleys and steep-sloped knife-


Arevalo Bay
700 deep, m
Leyte
Leyte R.
Naga R.
20'
C
Asphalt Mine
Villaba
C
E
Pagsanghahan R.
D
Palompon
D
11°
00'
C
D
Quiot
C
Merida
Tolingon
av.


225
150
35
80
220
75
Pinamopoan
Capoocan
Carigara
Barugo
F
E
B
F
16, sl
4.s
40
50
40
240
80
40
Alangalang
Jaro
45
10
85
F
F
A
Pastrana
Palo
Tano
Binahaan R.
Lake Danao
Dagami
50
20
60
40
3
20
3
100
Ormoc
70
Burauen
Mahaban R.
150
a v. 10, sl.
2, gr.
Albuera
A
La Paz
RMOC BAY
20-50; st., sl.
1-5, m&s.

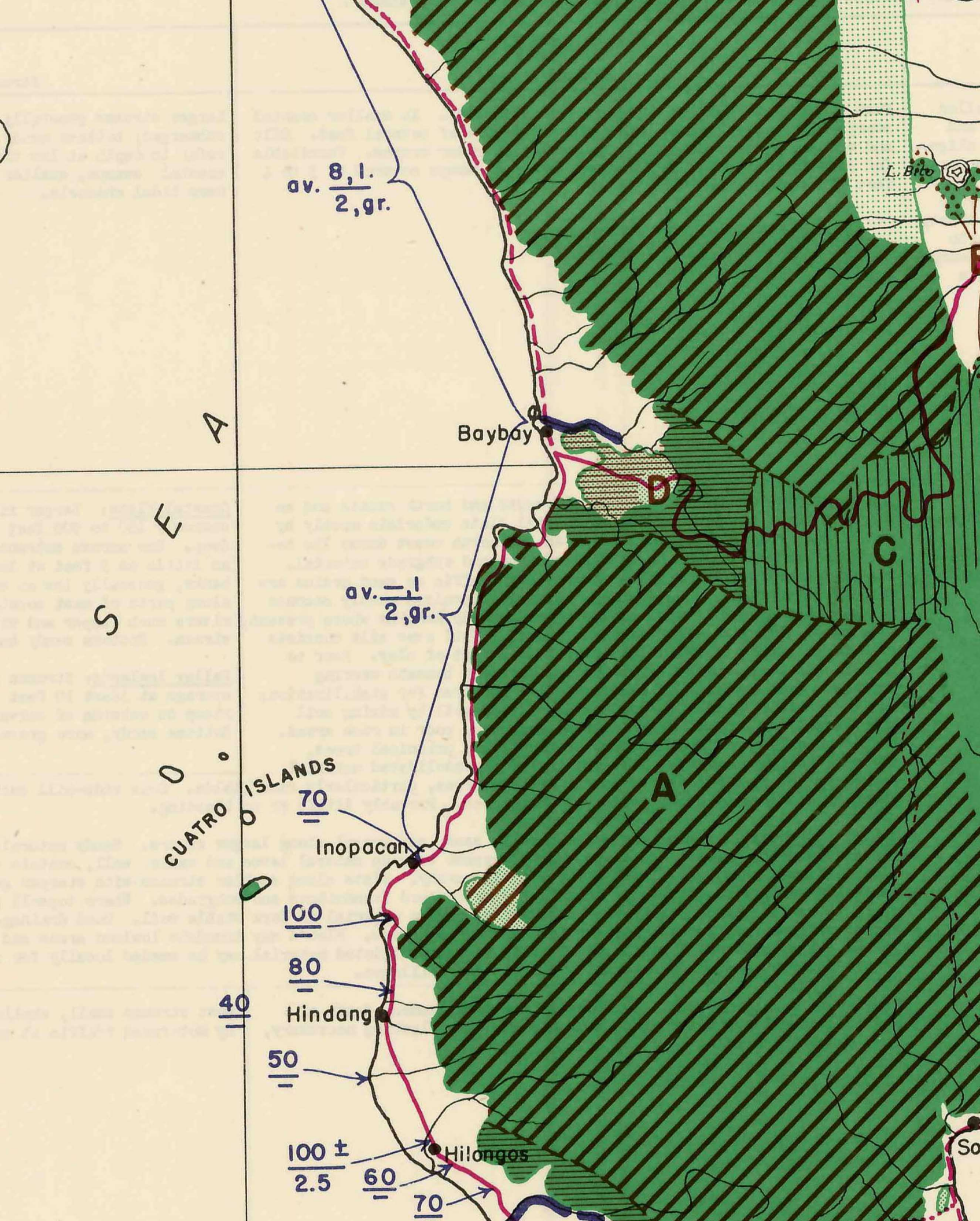

Abbreviations: sl, sloping; st, steep; l, low; m, mud; s, sand; gr, gravel; rk, rocky. Dash in place of number or abbreviation indicates data lacking.
Stream depth generally more than 5 feet.
Stream depth generally more than 3 feet; locally less.
Tacloban
SAN PEDRO BAY
Tolosa
Dulag
LEYTE GULF
80
250
60
220
30
270
190
170
3
3±
3±
7
2
B
20'
11°
00'

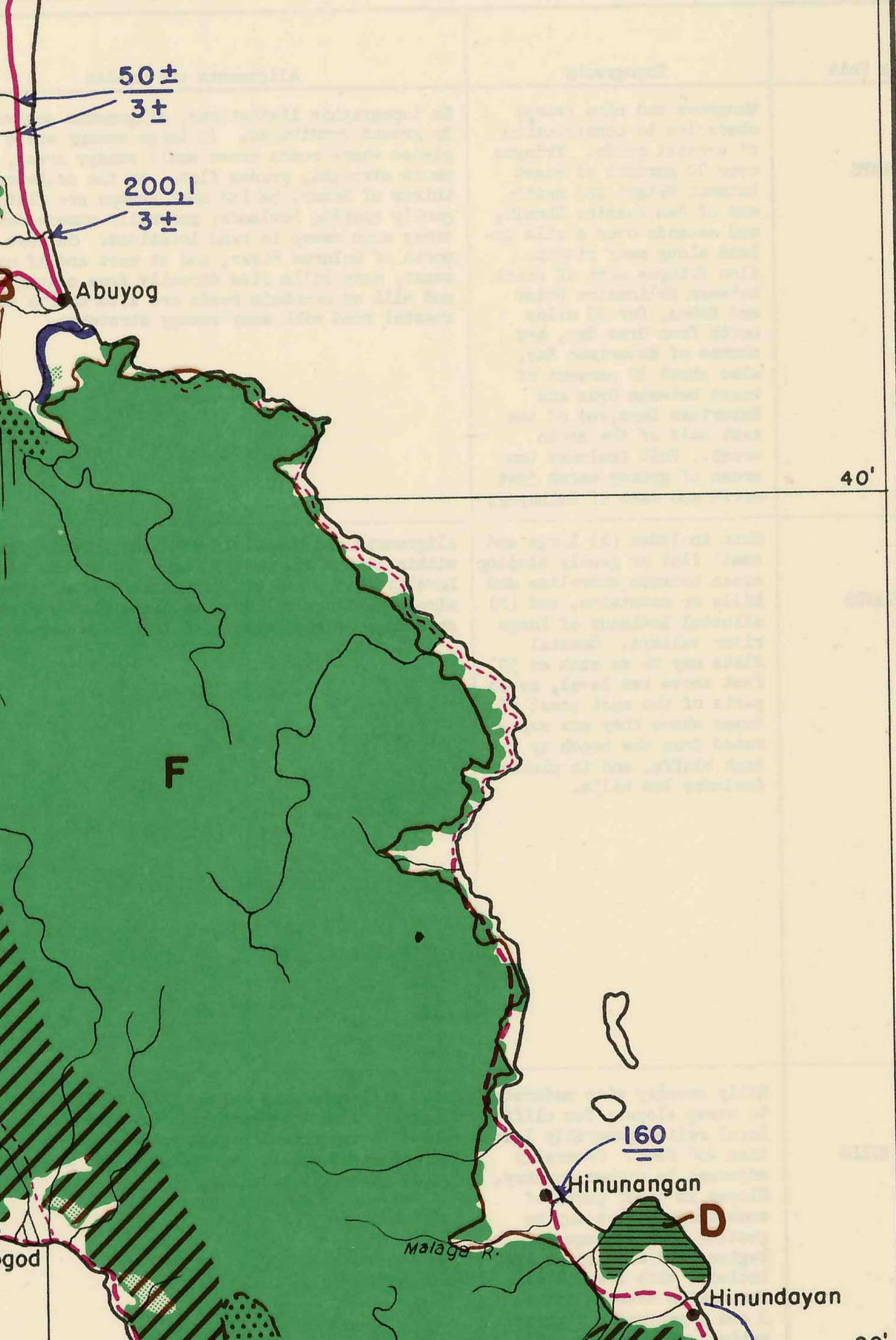


GROUND CONDITIONS EXPLANATION

Patterns and large letters refer to ground conditions in LOW HILLS and HIGH HILLS AND MOUNTAINS as described in Map Units in table.

A — Deep to shallow, granular, stony clay loam or clay over hard bedrock (trap). Fair to good foundation on gentler slopes, poor on steeper slopes; poor subgrade. May slide on steep slopes. Bedrock outcrops common in rugged


av. 8,1. / 2,gr.
Baybay
av. 1 / 2,gr.
CUATRO ISLANDS
70
Inopacan
100
80
40
Hindang
50
100 ± / 2.5
Hilongos
60
70
L. Biao
A
B
C
D
SEA


50±
3±
200,1
3±
Abuyog
40'
F
160
Hinunangan
D
Malaga R.
Hinundayan

areas, much blasting needed.

20'

B — Generally similar to Unit A, but contains some areas with micaceous soils and bedrock that make very poor foundations and subgrades, strong tendency to slide.

C — Clay soils, thin over shale. Poor foundations and subgrades, strong tendency to slide, little or no blasting required.

D — Clay loam and clay, shallow to deep over soft to hard limestone: fair to poor foundations, poor on very steep slopes, poor subgrade. In low-lying areas, most of grading in unconsolidated material. Considerable rock blasting in high rugged areas. Unit also includes some material like Unit C.

E — Sandy clay soils, generally thin over weathered bedrock; good to fair foundations, fair to unsuitable subgrade. Weathered rock in deep cuts may make good subgrade. Generally only minor blasting necessary. Includes some material like Unit C.

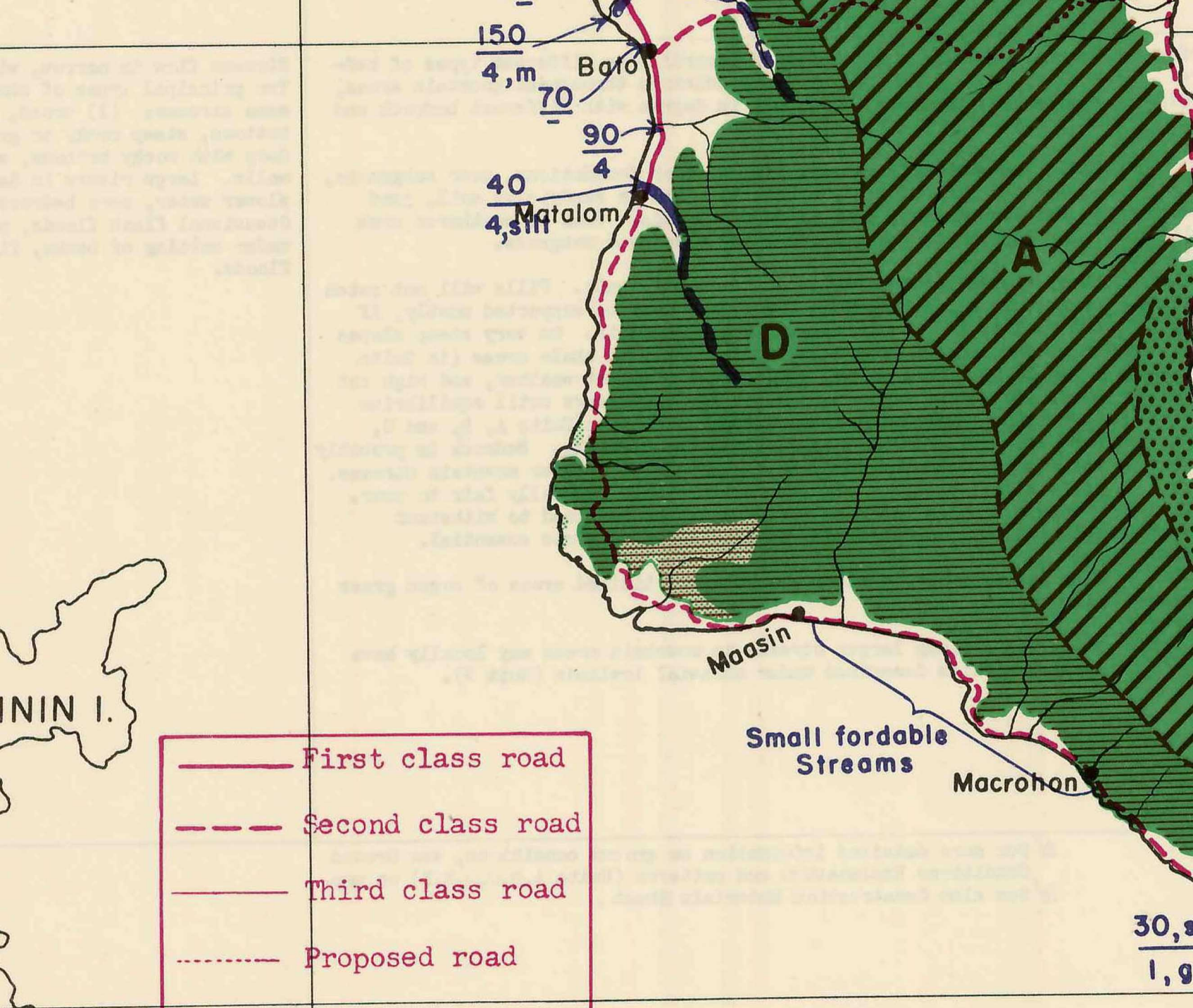
BOHOL

10° 00'

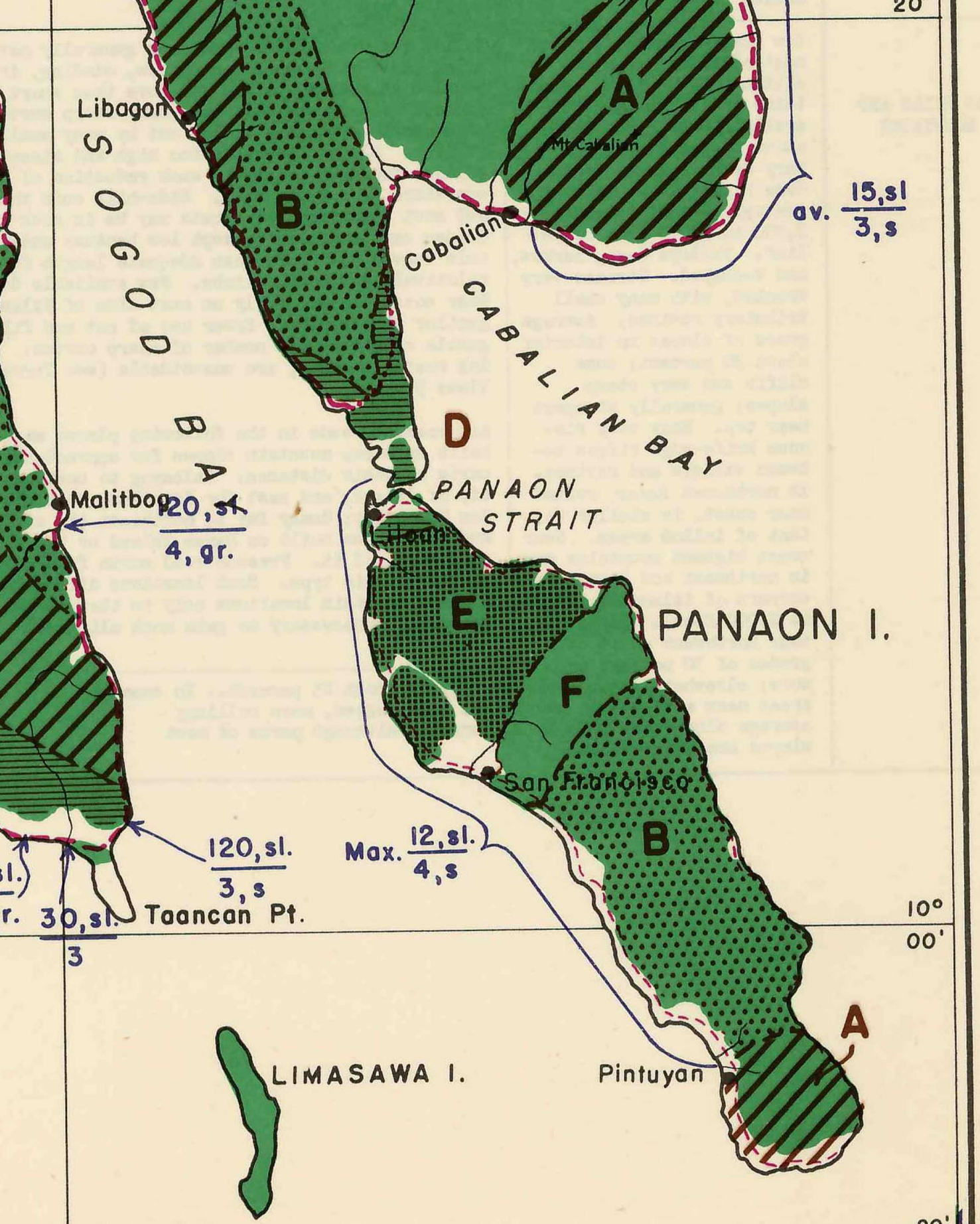
BF — Unknown ground conditions.

Topographic type overprint compiled from C. &. G. S coast charts (1:100,000); C. & G. S. Sheet No. 14 Leyte (1:200,000); military map of vicinity of Ormo (1:31,680); topographic map of northwest peninsula National Development Co. (1:50,000); various aeria photographs and ground views; published geologica reports and travelers accounts.

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Reliability: Fair

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Map Unit	Topography	Alignments and Grades	Ground Conditions [a]	Stream Crossings	Construction Materials Available [b]
SWAMPS	Large areas of mangrove swamp in northeast corner of Leyte and in Leyte Bay. Many scattered areas of mangrove and nipa swamp on coast and particularly at river mouths are too small to show on map. Fresh water marshes (not all shown on map), generally grassy or planted in rice, common in areas just behind sandy coastal strip (see Lowlands).	No topographic limitations; alignments controlled by ground conditions, and stream crossings.	Peat and muck on plastic clay. Incapable of supporting a road without fill. Generally under water. Covered by mangrove along shore, mangrove and nipa in brackish estuaries. Some inland swamps are grassy, as at Palo.	Larger streams generally wide and deep, have low or submerged banks, muddy bottoms. Depths of streams shown on map refer to depth at low tide in coastal areas. In areas of coastal swamps smaller streams may empty into very wide, deep tidal channels.	Mangrove available in coastal swamps. Gravel, and stone not available within swampy areas; beach sand locally available at seaward edges of swamps.
LOWLANDS	Map unit generally comprises narrow, sandy coastal strips behind beaches from a few hundred feet to a mile wide; areas of marshy ground that in some places lie behind the coastal strip at the seaward edge of the plain; the seaward parts of the large alluvial plains northeastern Leyte, near town of Ormoc, and Leyte and lower parts of large stream valleys; small coastal flats and the upper, inland parts of the large alluvial plains and coral terraces underlain by coral alluvium. On west coast of Leyte and on Camotes Island, less than 100 feet above sea level and rarely extend more than a mile or two inland.	Coastal strip: Flat, locally hummocky, areas adjacent to beaches; if continuous will accommodate straight, flat roads parallel to coast. On the southeastern, southern and northwestern coasts of Leyte, short stretches of coastal plain are separated by rocky headlands, and alignments in these places will be controlled by distribution and height of headlands. Swamps and rivers locally may restrict free choice of alignment. Narrowness of coastal strip limits detours;at many places coastal strip lies between beach and rice paddies, marshes, or steep slopes. Large alluvial plains: Long tangents generally possible, except as controlled by stream crossings. Scattered hills can be readily by-passed. Grades very gentle. Detours possible almost everywhere. Small coastal flats, river valleys near coast, and coral terraces: Alignments straight, grades flat but, because areas are small alignments and grades may be largely determined by topography of surrounding areas. Detours restricted.	Coastal strip: Calcareous sand, probably slightly cemented, derived from coral. Fair to good foundation and subgrade material. Adequate surfacing material for light traffic, but unsatisfactory wearing surface under heavy traffic in very wet or very dry weather as individual sand grains are readily pulverized. Well drained. Clearing of coconut palms necessary. Marshy areas behind coastal strip: (See Swamps, Map Unit 1) Generally grassy. Seaward parts of large coastal plains: (Northeastern Leyte, valleys around towns of Ormoc and Leyte): Plastic clay loam and clay; generally unsuitable for subgrade; poor foundation, particularly in low areas an in rainy season; requires addition of considerable sandy material for stabilization; poor drainage; underlain at depths of 1 to 4 feet by stratified clay, silt, sand and gravel. Largely under cultivation; mostly in rice. Little clearing necessary. Small coastal flats and upper inland portions of large coastal plains: Silty loam, 8 to 15 inches thick, over clay. Poor to fair foundation, not suitable for use directly under wearing surface. Moderate addition of sany material required for stabilization. Fair internal drainage. Underlain at depths of 2 to 4 feet by silty sand and gravel. In the large plains, the lower subsoil becomes coarser away from the coast, but the proportions of clay, silt, sand, and gravel are not known. Areas mostly under cultivation, commonly in abaca and rice. Little clearing necessary. Some grading needed to raise roads above rice fields. Coral terraces: Granular to plastic clay loam and clay over irregular surface of coral; volume changes greatly with moisture changes. Poor subgrade and foundation except where soil is thin. Poor to fair internal drainage but low water table. Areas largely under cultivation; little clearing necessary.	Coastal strip: Streams cross coastal strip in tidal estuaries, generally much wider and deeper than the same streams farther inland. Banks generally low and sloping, bottoms muddy in shallow water, sandy in deep water. Bars at mouths of most smaller streams can be forded on foot at low tide; otherwise streams not fordable. Alluvial plains, river valleys, and coral terraces: Streams wide and deep with sloping banks and muddy or silty bottoms within tidal limits (Naga River on Leyte Bay largest of this group). Beyond the limits of tidal influence streams wide and shallow; depths of 2 feet or less are common at low water,even in larger rivers. Generally one or both banks of larger rivers are steep and 10 to 20 feet high, require dugway approaches to fords. Bottoms sandy to gravelly. Smaller streams probably similar but narrower; banks may be lower. Usually from 2 to 8 flash floods per year, chiefly during winter months; last 1 or 2 days. Flood flows are commonly 2 to 10 times normal flow. During floods banks lower than 10 feet high are usually overflowed; channels may shift many hundreds of feet.	Coastal strip: Coconut trees generally abundant. Coastal strip locally adjacent mangrove forests. Coral sand on beaches. No stone and probably little or no gravel on coastal strip adjacent to large alluvial plains. Volcanic sand, gravel, and stone on coastal strips and beaches adjacent to mountain areas. Alluvial plains, large river valleys: Generally cultivated, timber other than coconut probably rare. Abundant sand, gravel, and hard stone in the larger stream channels above tidal influence; probably loose and very irregularly mixed at most places. Stream beds probably mostly sand near the coast; abundance and size of gravel increase towards mountains. Most boulders, both coarse and fine are probably fair grade of trap rock. Particularly near coast, sand probably requires washing to remove silt and clay if used for concrete aggregate. Suitable rock for crushing exists locally in hills behind and within coastal plains (see Construction Materials Sheet). At least 3 quarries in hills the plain of northeast Leyte; one in hard broken shale at Palo, another near Tanauan in soft sheared rock, and a third near Tacloban (type of rock unknown). Quarries at Palo and Tanauan will not provide large blocks for riprap.
GULLIED PLAINS AND BENCHLANDS	Gently sloping areas between the central mountain range and the large coastal plains of northeastern Leyte and near Ormoc. Streams flow from mountains in narrow ravines 20 to 350 feet deep, greatest depth near mountains	Fairly straight alignments possible in interstream areas, with very little grading. Grades 5 to 10 percent directly up slope toward mountains; higher grades close to mountains. Crossing ravines, especially near mountains, requires winding roads with moderately sharp turns, extensive side-hill cuts; few steep grades necessary. Small gullies probably common, particularly near large ravines.	Soil similar to and gradational into that of upper part of larger alluvial plains; may be somewhat sandier with less clay; provides fair foundation; poor to fair subgrade, poor when wet. Good surface drainage, but fresh cuts and ditches may require protection from gullying. Underlain at depths of 2 to 4 feet by silt, sand, and gravel, probably somewhat weathered. Side-hill cuts in ravines generally in unconsolidated material; some rock may require blasting, particularly near the mountains. Interstream areas partly under cultivation; some grassland and woods; minor clearing necessary. Areas near mountains and in deep ravines commonly heavily wooded.	Even at low water, small streams probably fill almost entire bottom of narrow V-shaped ravines. Large streams at normal flow; probably occupy fraction of valley bottoms. Steep or vertical gravel benches,as much as 20 feet above stream bottom, found locally along one or both sides of valleys. Floods may inundate river flats, and, at times, benches are flooded. Streams are shallow; gravel bottoms, locally rocky; fordable except when in flood.	Wooded areas, particularly on upper slopes, provide timber for construction. Sand and gravel, probably requiring washing to be suitable for concrete aggregate, abundant in valley bottoms; more or less weathered, poor-quality gravel occurs locally in the walls of ravines or beneath soil cover in interstream areas. Gravel and sand poorly sorted, usually cobbly or bouldery; contain abundant trap-rock fragments. Probably few or no bedrock areas in which a quarry could be opened.
LOW HILLS	Hilly country with moderate to steep slopes and some cliffs; local relief generally less than 250 feet, for the most part adjacent to high hills and mountains. Separation of units 4 and 5 is locally arbitrary.	Roads will have many curves. Side-hill cuts necessary almost everywhere. Grades need not be excessive as control points do not have large differences of elevation. Detours and alternate routes generally possible.	Essentially similar to mountains, (Unit 5). Rock ledges less common and depth of bedrock generally greater than in mountains; also less blasting necessary, less danger of slides.	Streams small, shallow, and rocky. Readily fordable by motorized units.	Similar to high hills and mountains (see Map Unit 5).
HIGH HILLS AND MOUNTAINS	High hills and mountains. Many deep, narrow, steep-sided valleys and steep-sloped knife-edge ridges. Local relief ranges from about 250 feet in outlying areas to over 1,500 feet in parts of central mountain range. Cliffs locally. No extensive flat or gently sloping areas.	Lower mountains (North half of northwest peninsula of Leyte and northeast and southwest corners of Leyte): Winding roads with sharp curves necessary Only minor reduction of curvature possible with extensive cut and fill. Slopes generally have grades over 25%. Side-hill cuts necessary almost everywhere. Grades can probably be kept low without switch-backs, if roads are aligned along contours. Higher mountains (Central range): Winding alignments, steep grades required for long distances; side-hill cuts necessary. Slopes are generally steeper and rockier near ridge tops. Cliffs probably can be avoided. Ridge-top locations generally not feasible because of narrowness, short radius curves, steep slopes. Roads rising from valley floor to divides have excessive grades at most places unless reduced by switchbacks. Coastal roads: In mountainous areas grades can be kept low, roads have some curves. Many small streams to cross. Amount of side-hill cuts around rocky headlands is inversely proportional to number and size of small coastal plain areas shown on map. Slopes steeper where mountains extend to shore.	Mountain areas are subdivided according to different types of soil and bedrock. General ground conditions depend largely upon slope and vary only in degree with different bedrock and soil types. Most of the soils are clayey, fair to poor foundations, poor subgrades, except for much of the soil in Unit E which is sandy clay, good to fair foundation, fair to poor subgrade. Some of the disintegrated rock below topsoil in Unit E make good subgrade. Steep slopes require continuous side-hill cuts. Fills will not catch on steeper slopes and road foundations most be supported mostly, if not wholly, in cuts, or by artificial support. On very steep slopes in clay soils and disintegrated bedrock, and in bedrock cuts in shales (Units C,D,and E). Foundations may slide locally in wet weather, and high cut banks are almost certain to slide for many years until equilibrium is reached. Particularly on steeper slopes in Units A,B,D, and to a lesser extent E, some cuts will be in rocks that require blasting. Elsewhere grading is in soft materials. Bedrock is probably most abundant in and above channels of smaller mountain streams. Surface drainage is good, internal drainage fair to poor (very poor in Unit C). Drainage ditches and road surfaces should be designed to withstand severe erosion during heavy rains, large culverts essential. Much heavy timber must be cleared everywhere. Limited areas of cogon grass near coast.	Streams flow in narrow, winding, steep-walled valleys. Two principal types of channels in different parts of same streams: (1) broad, shallow, with gravelly and bouldery bottoms and steep rocky or gravelly banks, (2) narrow and deep with rocky bottom, waterfalls and steep, cliffed walls. All gradations may be found, and transitions may be abrupt. Occasional flash floods, particularly in winter. Extreme undercutting of banks, fills, and abutments during floods.	Generally heavily wooded except on lowermost slopes abundant timber. Suitable for heavy construction. Mountains in north half of northwest peninsula largely grass-covered. Large deposits of sand and gravel exist only along larger streams. Gravel in and along stream banks usually is bouldery and very pockety. In central range and Biliran Island boulders and gravel largely hard, trap-like rock. Northwest peninsula, northeast corner of the island, and east side of Sogod Bay, gravels contain much soft rock. Sand and gravel probably require screening and washing for use in concrete. Trap rock for crushed stone or riprap is abundant in the central range, on Mt. Cabalian (southeast tip), and on Biliran Island. Local areas of inferior trap rock exist on the east and west sides of Sogod Bay and in isolated spots in mountains of northwest peninsula. Hard limestone locally present near east margin of area in northeastern Leyte, also in southern half of northwest peninsula. A small deposit of asphaltic sand 1.2 miles west of Baliti, on the west coast of the northwest peninsula, has been exploited for bituminous road surfacing. The deposit probably is small and may have been worked out.

[a] For more detailed information on ground conditions, see Ground Conditions Explanation and patterns (Units A,B,C,D,E,F) on map.

[b] See also Construction Materials Sheet.

Prepared by U.S. Geological Survey
for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

Map Unit	Topography	Alignments and Grades
SWAMPS	Large areas of mangrove swamp in northeast corner of Leyte and in Leyte Bay. Many scattered areas of mangrove and nipa swamp on coast and particularly at river mouths are too small to show on map. Fresh water marshes (not all shown on map), generally grassy or planted in rice, common in areas just behind sandy coastal strip (see Lowlands).	No topographic limitations; alignments by ground conditions, and stream cross

[redacted]

Reliability: Fair

LEYTE

	Ground Conditions [a]	
s controlled sings.	Peat and muck on plastic clay. Incapable of supporting a road without fill. Generally under water. Covered by mangrove along shore, mangrove and nipa in brackish estuaries. Some inland swamps are grassy, as at Palo.	Larger streams ge merged banks, mud map refer to depth areas of coastal very wide, deep ti

ROAD CONSTRUCTION AND MAINTENANCE

Stream Crossings	Construction Materials Available b/
nerally wide and deep, have low or sub-dy bottoms. Depths of streams shown on n at low tide in coastal areas. In swamps smaller streams may empty into idal channels.	Mangrove available in coastal swamps. Gravel, and stone not available within swampy areas; beach sand locally available at seaward edges of swamps.

LOWLANDS	Map unit generally comprises narrow, sandy coastal strips behind beaches from a few hundred feet to a mile wide; areas of marshy ground that in some places lie behind the coastal strip at the seaward edge of the plain; the seaward parts of the large alluvial plains northeastern Leyte, near town of Ormoc, and Leyte and lower parts of large stream valleys; small coastal flats and the upper, inland parts of the large alluvial plains and coral terraces underlain by coral alluvium. On west coast of Leyte and on Camotes Island, less than 100 feet above sea level and rarely extend more than a mile or two inland.	Coastal strip: Flat, locally hummocky, jacent to beaches; if continuous will straight, flat roads parallel to coast southeastern, so uthern and northwester Leyte, short stretches of coastal plai rated by rocky headlands, and alignmen places will be controlled by distribut of headlands. Swamps and rivers local free choice of alignment. Narrowness strip limits detours;at many places co lies between beach and rice paddies, m steep slopes. Large alluvial plains: Long tangents g possible, except as controlled by stre Scattered hills can be readily by-pass very gentle. Detours possible almost Small coastal flats, river valleys nea coral terraces: Alignments straight, but, because areas are small alignment may be largely determined by topograph ing areas. Detours restricted.
GULLIED PLAINS AND BENCHLANDS	Gently sloping areas between the central mountain range and the large coastal plains of northeastern Leyte and near Ormoc. Streams flow from mountains in narrow ravines 20 to 350 feet deep, greatest depth near mountains	Fairly straight alignments possible in areas, with very little grading. Grad percent directly up slope toward mount grades close to mountains. Crossing r pecially near mountains, requires wind with moderately sharp turns, extensive cuts; few steep grades necessary. Sma probably common, particularly near lar
LOW HILLS	Hilly country with moderate to steep slopes and some cliffs; local relief generally less than 250 feet, for the most part adjacent to high hills and mountains. Separation of units 4 and 5 is locally arbitrary.	Roads will have many curves. Side-hil necessary almost everywhere. Grades n excessive as control points do not hav differences of elevation. Detours and routes generally possible.
HIGH HILLS AND MOUNTAINS	High hills and mountains. Many deep, narrow, steep-sided valleys and steep-sloped knife-edge ridges. Local relief ranges from about 250 feet in outlying areas to over 1,500 feet in parts of central mountain range. Cliffs locally. No extensive flat or gently sloping areas.	Lower mountains (North half of northw of Leyte and northeast and southwest c Leyte): Winding roads with sharp curv Only minor reduction of curvature poss extensive cut and fill. Slopes genera grades over 25%. Side-hill cuts neces everywhere. Grades can probably be ke out switch-backs, if roads are aligned tours. Higher mountains (Central range): Win ments, steep grades required for long side-hill cuts necessary. Slopes are

areas ad- accommodate . On the n coasts of n are sepa- ts in these ion and height ly may restrict of coastal astal strip arshes, or enerally am crossings. ed. Grades everywhere. r coast, and grades flat s and grades y of surround-	<u>Coastal strip</u>: Calcareous sand, probably slightly cemented, derived from coral. Fair to good foundation and subgrade material. Adequate surfacing material for light traffic, but unsatisfactory wearing surface under heavy traffic in very wet or very dry weather as individual sand grains are readily pulverized. Well drained. Clearing of coconut palms necessary. <u>Marshy areas behind coastal strip</u>: (See Swamps, Map Unit 1) Generally grassy. <u>Seaward parts of large coastal plains</u>: (Northeastern Leyte, valleys around towns of Ormoc and Leyte): Plastic clay loam and clay; generally unsuitable for subgrade; poor foundation, particularly in low areas an in rainy season; requires addition of considerable sandy material for stabilization; poor drainage; underlain at depths of 1 to 4 feet by stratified clay, silt, sand and gravel. Largely under cultivation; mostly in rice. Little clearing necessary. <u>Small coastal flats and upper inland portions of large coastal plains</u>: Silty loam, 8 to 15 inches thick, over clay. Poor to fair foundation, not suitable for use directly under wearing surface. Moderate addition of sany material required for stabilization. Fair internal drainage. Underlain at depths of 2 to 4 feet by silty sand and gravel. In the large plains, the lower subsoil becomes coarser away from the coast, but the proportions of clay, silt, sand, and gravel are not known. Areas mostly under cultivation, commonly in abaca and rice. Little clearing necessary. Some grading needed to raise roads above rice fields. <u>Coral terraces</u>: Granular to plastic clay loam and clay over irregular surface of coral; volume changes greatly with moisture changes. Poor subgrade and foundation except where soil is thin. Poor to fair internal drainage but low water table. Areas largely under cultivation; little clearing necessary.	<u>Coastal strip</u>: Str aries, generally m streams farther in bottoms muddy in s Bars at mouths of foot at low tide; <u>Alluvial plains, r</u> Streams wide and d silty bottoms with Bay largest of thi influence streams less are common at Generally one or b and 10 to 20 feet Bottoms sandy to g similar but narrow 2 to 8 flash flood last 1 or 2 days. normal flow. Duri are usually overfl of feet.
interstream es 5 to 10 ains; higher avines, es- ing roads side-hill ll gullies ge ravines.	Soil similar to and gradational into that of upper part of larger alluvial plains; may be somewhat sandier with less clay; provides fair foundation; poor to fair subgrade, poor when wet. Good surface drainage, but fresh cuts and ditches may require protection from gullying. Underlain at depths of 2 to 4 feet by silt, sand, and gravel, probably somewhat weathered. Side-hill cuts in ravines generally in unconsolidated material; some rock may require blasting, particularly near the mountains. Interstream areas partly under cultivation; some grassland and woods; minor clearing necessary. Areas near mountains and in deep ravines commonly heavily wooded.	Even at low water, entire bottom of n at normal flow; pr bottoms. Steep or feet above stream sides of valleys. at times, benches Streams are shallo able except when i
l cuts eed not be e large alternate	Essentially similar to mountains, (Unit 5). Rock ledges less common and depth of bedrock generally greater than in mountains; also less blasting necessary, less danger of slides.	Streams small, sha motorized units.
est peninsula orners of es necessary ible with lly have sary almost ot low with- along con- ding align- distances; generally	Mountain areas are subdivided according to different types of soil and bedrock. General ground conditions depend largely upon slope and vary only in degree with different bedrock and soil types. Most of the soils are clayey, fair to poor foundations, poor subgrades, except for much of the soil in Unit E which is sandy clay, good to fair foundation, fair to poor subgrade. Some of the disintegrated rock below topsoil in Unit E make good subgrade. Steep slopes require continuous side-hill cuts. Fills will not catch on steeper slopes and road foundations most be supported mostly, if not wholly, in cuts, or by artificial support. On very steep slopes in clay soils and disintegrated bedrock, and in bedrock cuts in	Streams flow in na Two principal type streams: (1) broa bottoms and steep r deep with rocky bo walls. All gradat be abrupt. Occasi winter. Extreme u abutments during f

reams cross coastal strip in tidal estu- uch wider and deeper than the same land. Banks generally low and sloping, shallow water, sandy in deep water. most smaller streams can be forded on otherwise streams not fordable. river valleys, and coral terraces: deep with sloping banks and muddy or in tidal limits (Naga River on Leyte s group). Beyond the limits of tidal wide and shallow; depths of 2 feet or low water, even in larger rivers. oth banks of larger rivers are steep high, require dugway approaches to fords. ravelly. Smaller streams probably er; banks may be lower. Usually from s per year, chiefly during winter months; Flood flows are commonly 2 to 10 times ng floods banks lower than 10 feet high owed; channels may shift many hundreds	Coastal strip: Coconut trees generally abundant. Coastal strip locally adjacent mangrove forests. Coral sand on beaches. No stone and probably little or no gravel on coastal strip adjacent to large alluvial plains. Volcanic sand, gravel, and stone on coastal strips and beaches adjacent to mountain areas. Alluvial plains, large river valleys: Generally cultivated, timber other than coconut probably rare. Abundant sand, gravel, and hard stone in the larger stream channels above tidal influence; probably loose and very irregularly mixed at most places. Stream beds probably mostly sand near the coast; abundance and size of gravel increase towards mountains. Most boulders, both coarse and fine are probably fair grade of trap rock. Particularly near coast, sand probably requires washing to remove silt and clay if used for concrete aggregate. Suitable rock for crushing exists locally in hills behind and within coastal plains (see Construction Materials Sheet). At least 3 quarries in hills the plain of northeast Leyte; one in hard broken shale at Palo, another near Tanauan in soft sheared rock, and a third near Tacloban (type of rock unknown). Quarries at Palo and Tanauan will not provide large blocks for riprap.
small streams probably fill almost arrow V-shaped ravines. Large streams obably occupy fraction of valley vertical gravel benches, as much as 20 bottom, found locally along one or both Floods may innundate river flats, and, are flooded. w; gravel bottoms, locally rocky; ford- n flood.	Wooded areas, particularly on upper slopes, provide timber for construction. Sand and gravel, probably requiring washing to be suitable for concrete aggregate, abundant in valley bottoms; more or less weathered, poor-quality gravel occurs locally in the walls of ravines or beneath soil cover in interstream areas. Gravel and sand poorly sorted, usually cobbly or bouldery; contain abundant trap-rock fragments. Probably few or no bedrock areas in which a quarry could be opened.
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Cliffs cations ownness, short sing from grades at cks.	shales (Units C,D,and E). Foundations may slide locally in wet weather, and high cut banks are almost certain to slide for many years until equilibrium is reached. Particularly on steeper slopes in Units A,B,D, and to a lesser extent E, some cuts will be in rocks that require blasting. Elsewhere grading is in soft materials. Bedrock is probably most abundant in and above channels of smaller mountain streams. Surface drainage is good, internal drainage fair to poor (very poor in Unit C). Drainage ditches and road surfaces should be designed to withstand severe erosion during heavy rains, large culverts essential. Much heavy timber must be cleared everywhere. Limited areas of cogon grass near coast.	
ades can be small cuts around nal to areas shown extend to		

a/ For more detailed information on ground conditions, see Ground Conditions Explanation and patterns (Units A,B,C,D,E,F) on map.
b/ See also Construction Materials Sheet.

[redacted]

	gravel probably require screening and washing for use in concrete. Trap rock for crushed stone or riprap is abundant in the central range, on Mt. Cabalian (southeast tip), and on Biliran Island. Local areas of inferior trap rock exist on the east and west sides of Sogod Bay and in isolated spots in mountains of northwest peninsula. Hard limestone locally present near east margin of area in northeastern Leyte, also in southern half of northwest peninsula. A small deposit of asphaltic sand 1.2 miles west of Baliti, on the west coast of the northwest peninsula, has been exploited for bituminous road surfacing. The deposit probably is small and may have been worked out.

Prepared by U.S. Geological Survey
for Chief of Engineers, U. S. Army.

PHILIPPINE ISLANDS 1:500,000

SOILS

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SAN BERNARDINO STRAIT

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)



PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

Reliability: Poor

1 250 000 YARDS

Scale 1:500,000

A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMIRM), U. S. Army, Washington, D. C., 1944.
Compiled from: Sectional Aeronautical Chart, 1:600,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1922; No. 13, 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1908. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Modified Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Hq. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

LEGEND

Road, surfaced, all-weather
Road, partially surfaced, generally all-weather
Track, Trail
Road under construction, 1941
Boundary, International Treaty Limits
Boundary, Provincial
Boundary, Chartered City
Railroad, 3'6" gauge; with Station
Railroad, Less than 3'6" gauge
Railroad, Electric (ELECTRIFIED)
Telephone and Telegraph Line
Power Transmission Line

City, First Importance — MANILA
City, Second Importance — DAVAO
City or Large Town — Tagum
Small Town — Peña
Village or Settlement — Kalan
Aerodrome, Auxiliary Landing Field
Seaplane Base, Auxiliary Anchorage
Principal Navigation Light
Radio Station
Telephone Station, Telegraph Station
Mud Flat, Tidal Flat
Mangrove

CONVERSION GRAPH NOT at the scale of the map.

Meters / Feet

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID. THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK NEEDED CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1945 FOR CENTER OF SHEET. ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliability fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

PROVINCES
1. ALBAY
2. SORSOGON
3. SAMAR
4. MASBATE

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1944

Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

68

PHILIPPINE ISLANDS 1:500,000

SOILS

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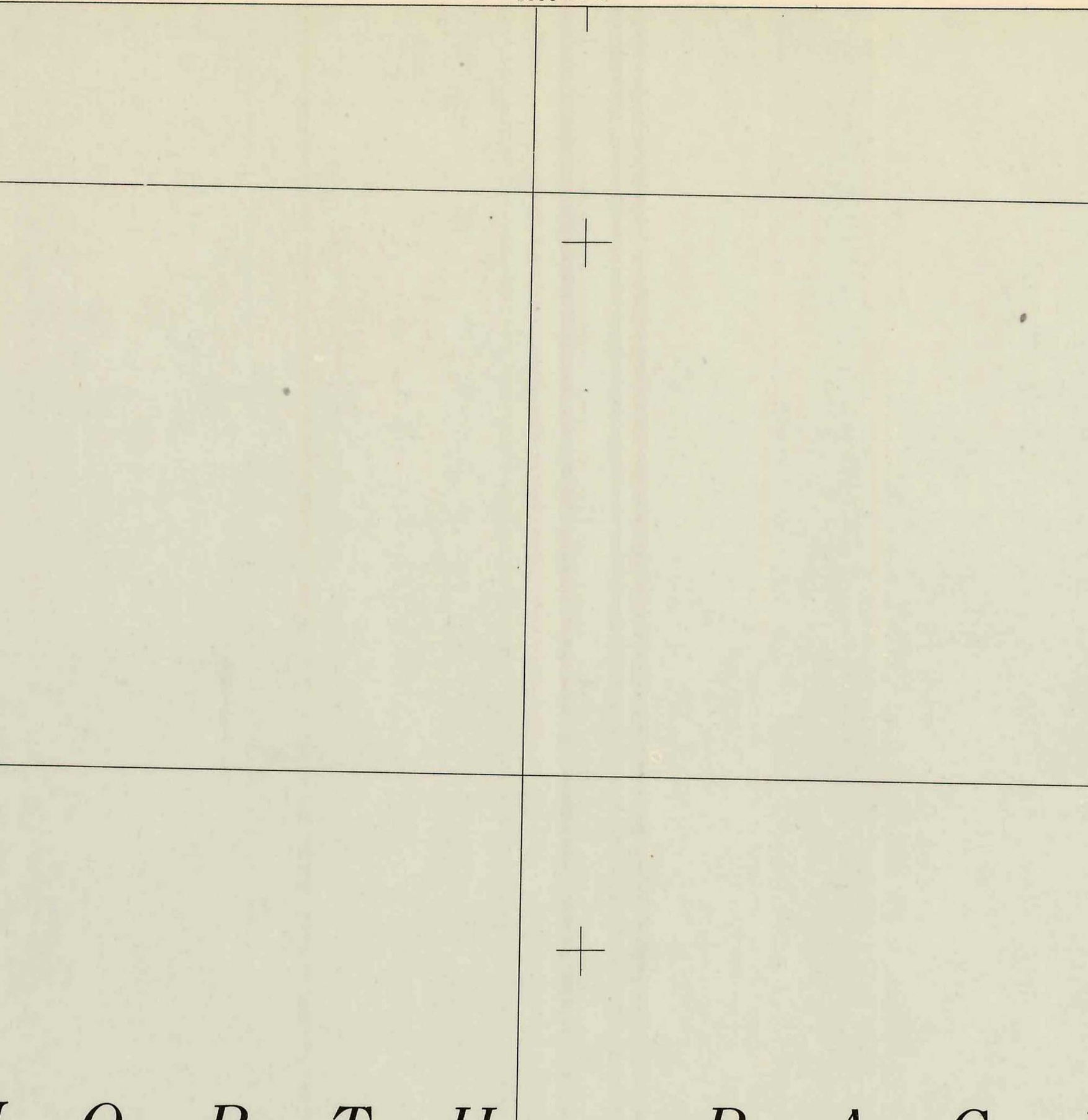


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SAN BERNARDINO STRAIT

1350 125°00′



SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)

1400 30′ 1450 126°00′ 14° 10′

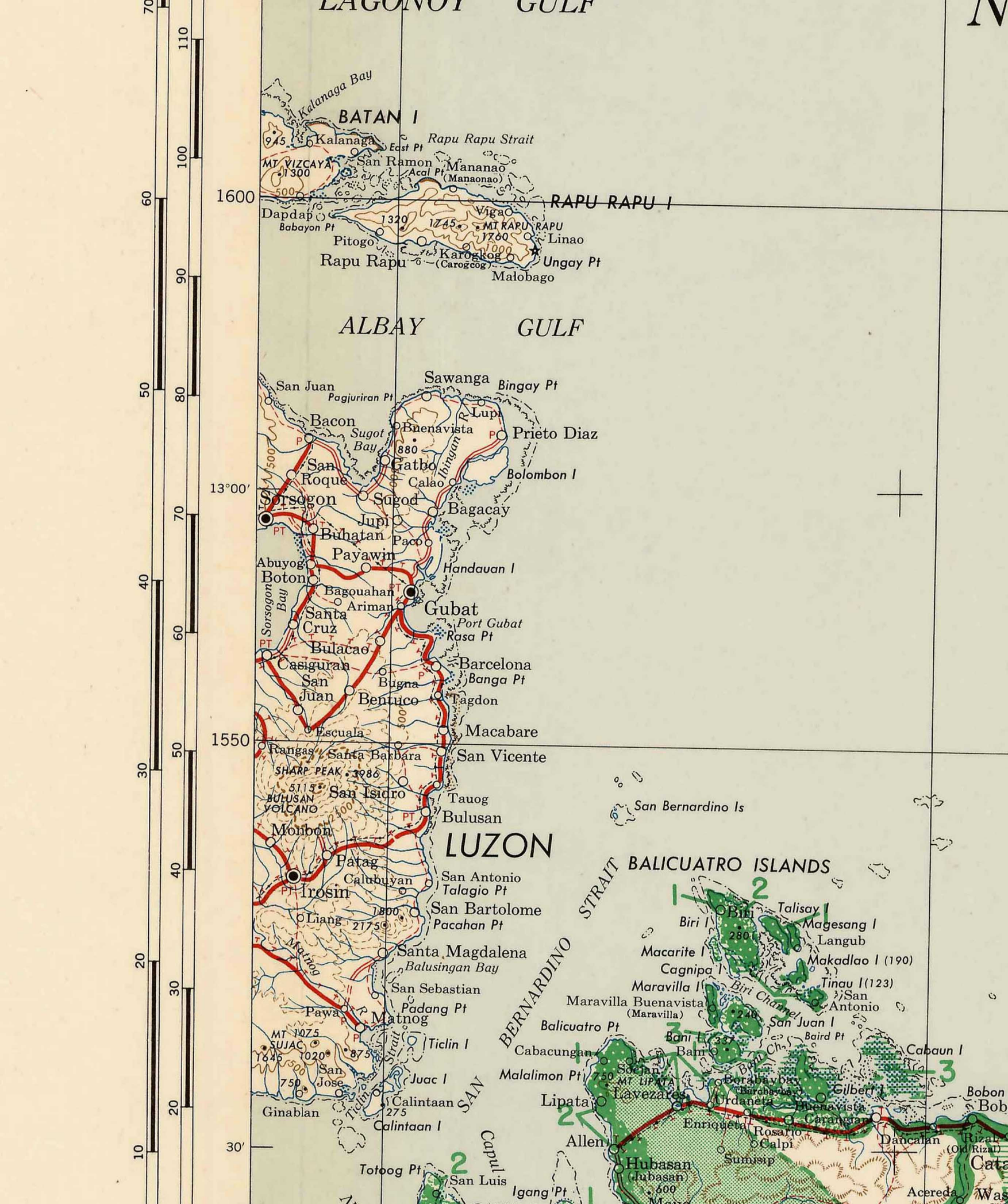
GRID DECLINATION 0°58′E

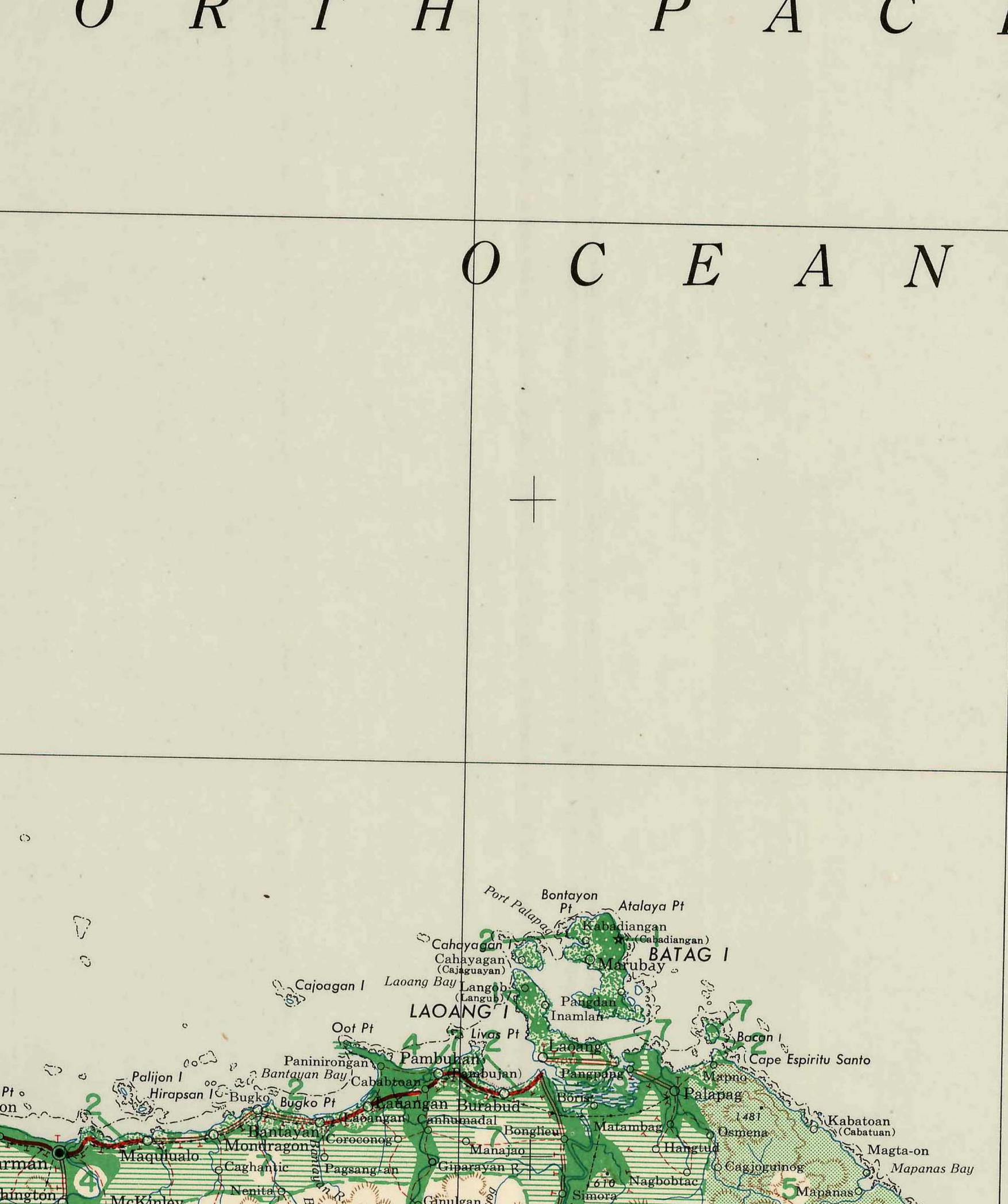
1700

14°00′

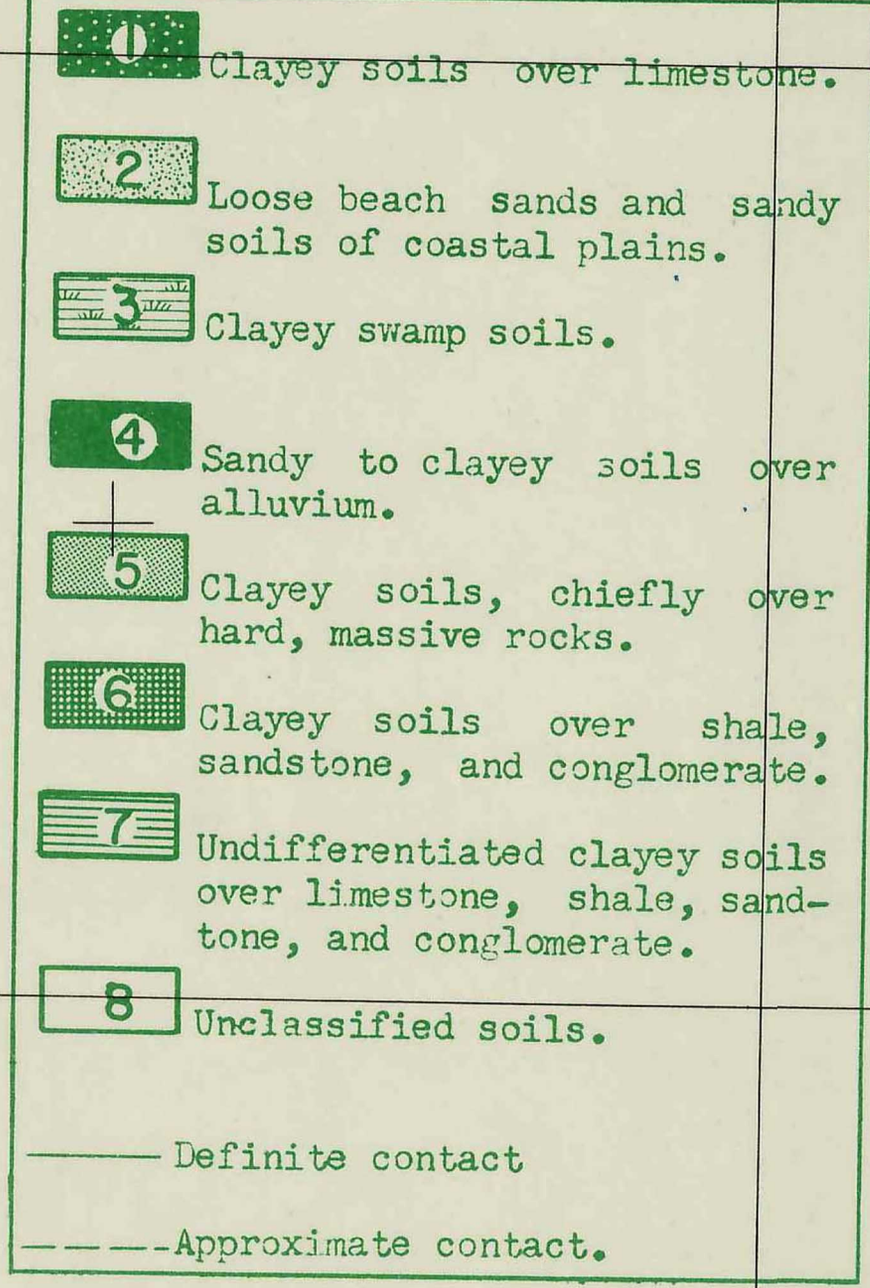
1650

30′


LAGONOY GULF
Kalanaga Bay
BATAN I
945
Kalanaga
East Pt
Rapu Rapu Strait
MT VIZCAYA
1300
San Ramon
Acal Pt
Mananao
(Manaonao)
1600
RAPU RAPU I
Dapdap
Babayon Pt
1320
1745
MT RAPU RAPU
1760
Viga
Linao
Pitogo
Karogkog
(Carogcog)
Ungay Pt
Rapu Rapu
Malobago
ALBAY GULF
San Juan
Pagjuriran Pt
Sawanga
Bingay Pt
Lupi
Bacon
Sugot Bay
Buenavista
Prieto Diaz
880
Gatbo
Ibingan R
San Roque
Calao
Bolombon I
13°00′
Sorsogon
Sugod
Bagacay
Jupi
Buhatan
Paco
Payawin
Abuyog
Handavan I
Boton
Bagouahan
Ariman
Gubat
Sorsogon Bay
Santa Cruz
Port Gubat
Rasa Pt
Bulacao
Casigurah
Barcelona
Banga Pt
San Juan
Bugna
Bentuco
Tagdon
Escuala
Macabare
1550
Rangas
Santa Barbara
San Vicente
SHARP PEAK
3986
5115
BULUSAN VOLCANO
San Isidro
Tauog
Bulusan
San Bernardino Is
Monbon
LUZON
Patag
Irosin
Calubuyan
San Antonio
Talagio Pt
San Bartolome
Liang
1800
2175
Pacahan Pt
STRAIT
BALICUATRO ISLANDS
BERNARDINO
Santa Magdalena
Balusingan Bay
Matnog
San Sebastian
Padang Pt
Pawa
Matnog
MT IOZ5
SUJAC
1645
1020
875
Ticlin I
Strait
San Jose
750
Juac I
Ginablan
Calintaan
275
Calintaan I
SAN
Biri
Talisay I
Biri I
280
Magesang I
Langub
Macarite I
Makadlao I (190)
Cagnipa I
Tinau I (123)
Maravilla I
Biri Channel
Maravilla Buenavista
(Maravilla)
San Antonio
248
San Juan I
Balicuatro Pt
Bani
337
Baird Pt
Cabacungan
Cabaun I
Malalimon Pt
750
Socian
MT LIPATA
Borabaybay
Barabay bay
Lavezares
Gilbert I
Lipata
Urdaneta
Buenavista
Bobon
Enriqueta
Rosario
Calpi
Allen
Dancalan
Sumisip
Hubasan
(Jubasan)
600
Totoog Pt
San Luis
Igang Pt
Capul
30′
Acereda


O R T H P A C
O C E A N
Port Palapag
Bontayon Pt
Atalaya Pt
Kabadiangan
(Cabadiangan)
Cahayagan I
Cahayagan
(Cajaguayan)
BATAG I
Marubay
Cajoagan I
Laoang Bay
Langob
(Langub)
Palgdan
LAOANG I
Inamlan
Oot Pt
Livas Pt
Laoang
Bacon I
Cape Espiritu Santo
Paninirongan
Pambuhan
(Pambujan)
Pangpang
Mapno
Palijon I
Bantayan Bay
Cababtoan
Hirapsan I
Bugko
Bugko Pt
Burabud
Boris
Palapag
Laoangan
Canhumadal
Matambag
1481
Kabatoan
(Cabatuan)
Bantayan
Coroconog
Bonglieu
Osmena
Mondragon
Manajao
Hangtud
Magta-on
Maqulualo
Caghantic
Pagsangan
Giparayan R
Cagjoguinog
Mapanas Bay
Nenita
Nagbobtac
Simora
Mapanas
Ganulgan

F I C



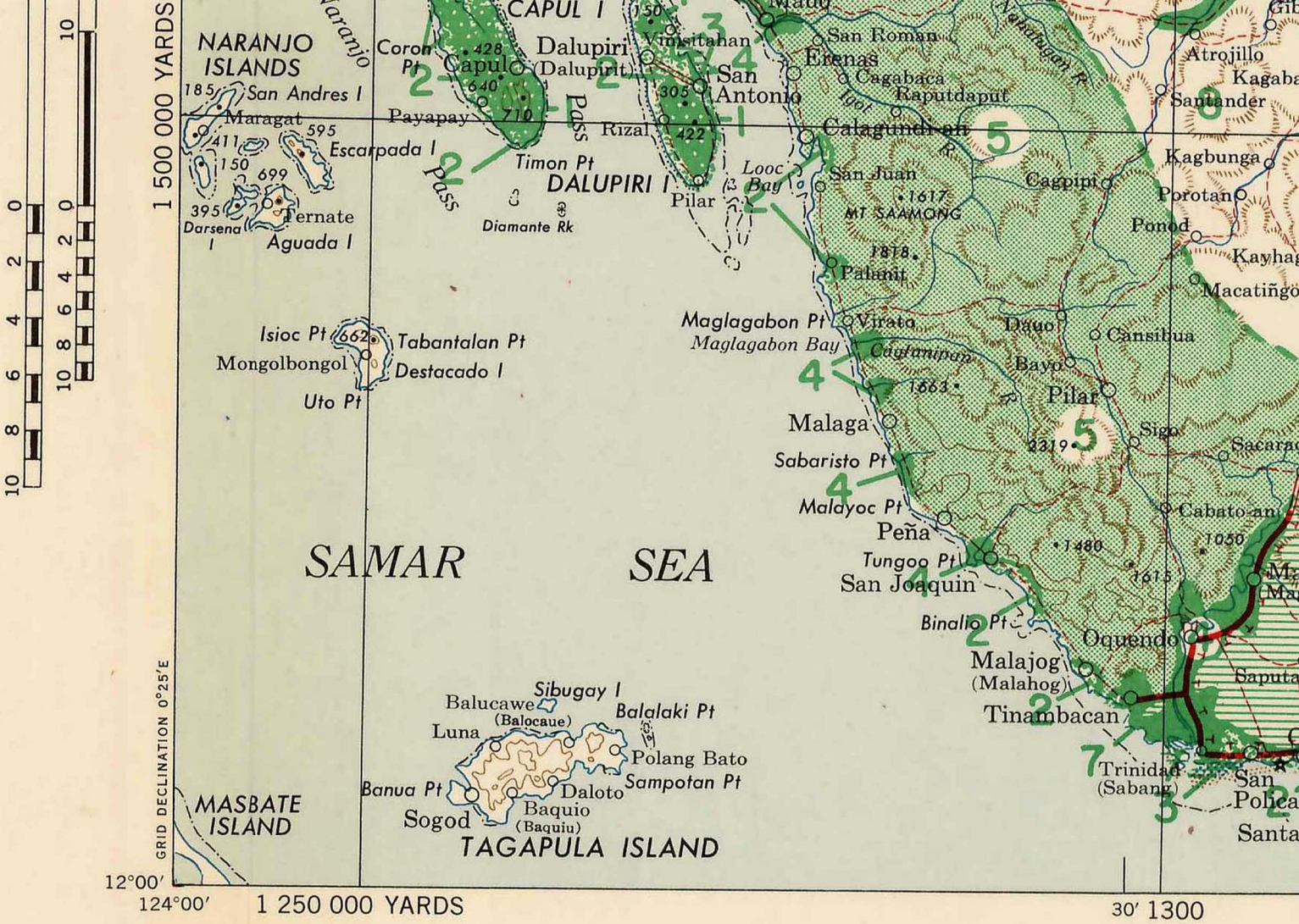
PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

1600

13°00′

1550

30′



A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.

Compiled from: Sectional Aeronautical Chart, 1:600,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1932; No. 13, 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1908. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Hq. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

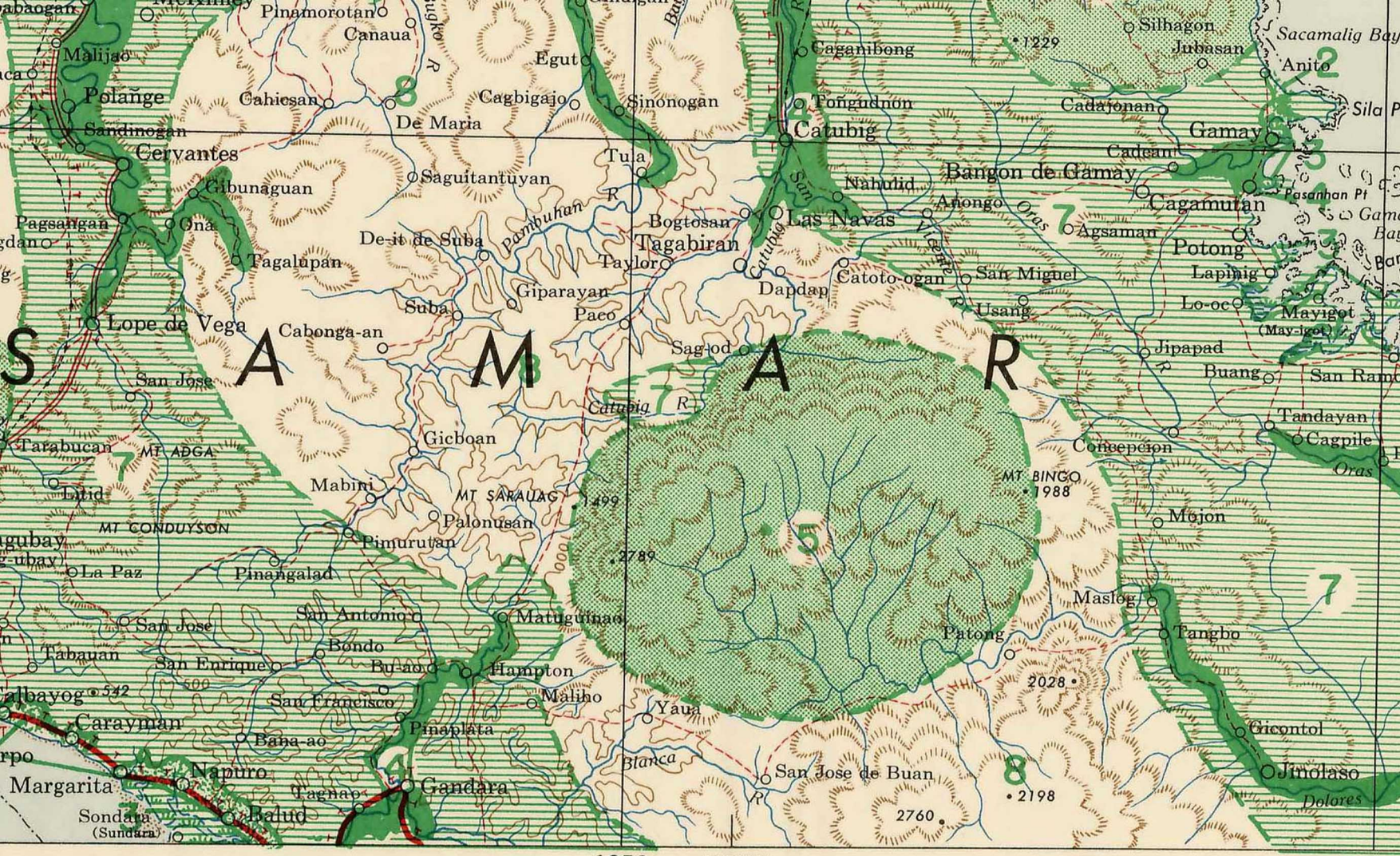
CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
	2,000
500	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line

- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

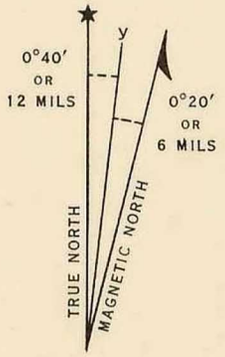
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

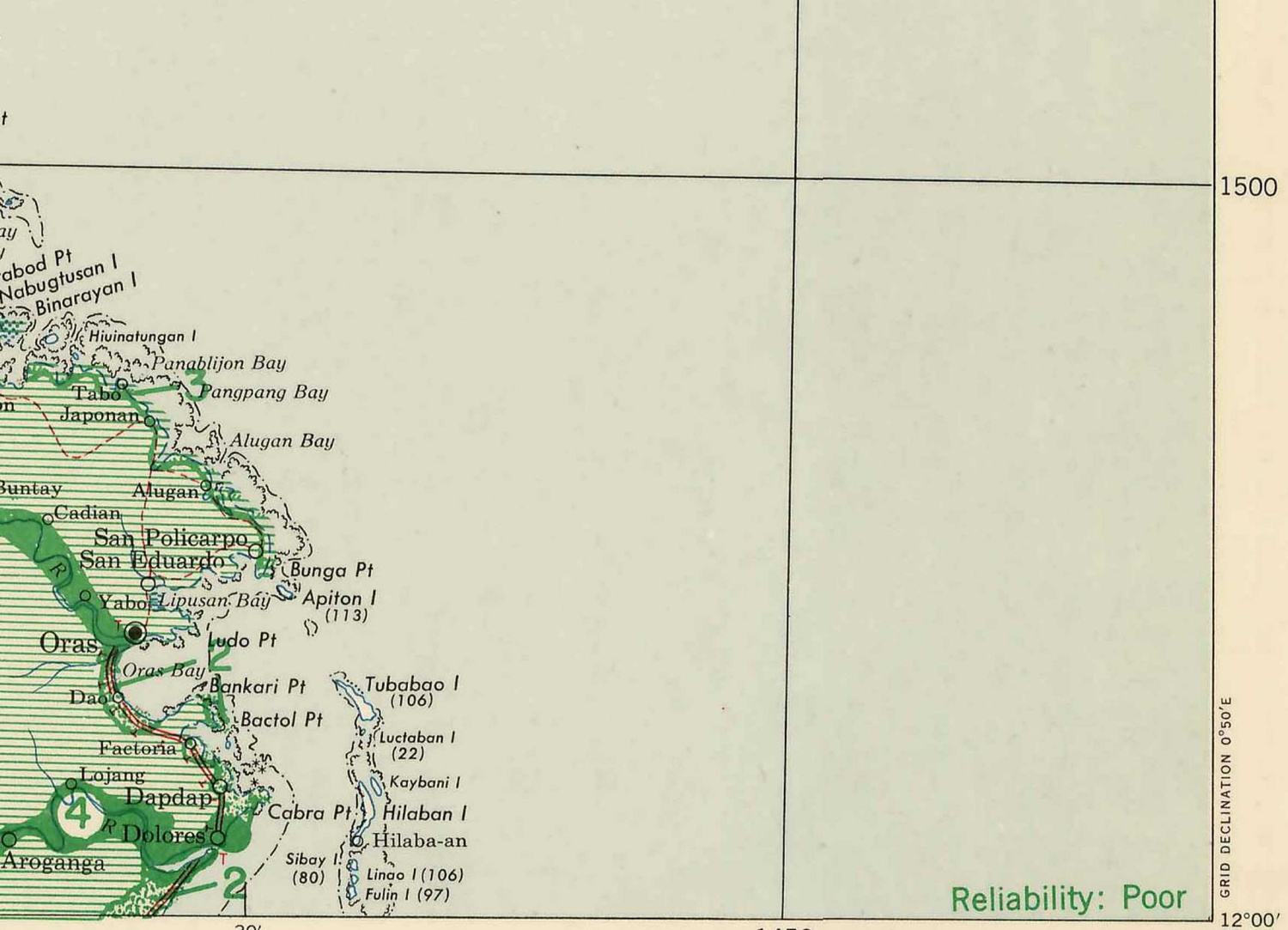


APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1′ INCREASE

Do not use diagram except to obtain numerical value of angles

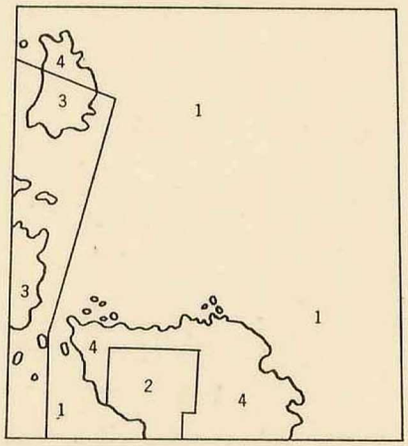
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS



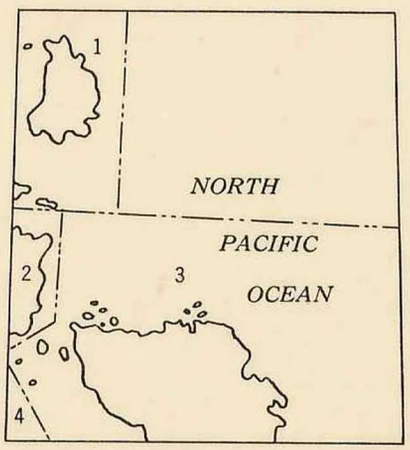
ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090
9-44 1944

COVERAGE DIAGRAM



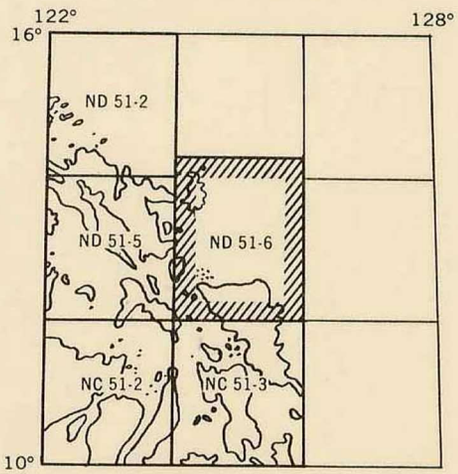
1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliabilty fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

INDEX TO BOUNDARIES



PROVINCES
1. ALBAY
2. SORSOGOR
3. SAMAR
4. MASBATE

INDEX TO ADJOINING SHEETS



Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

[redacted]

PHILIPPINE ISLANDS 1:500,000

SOILS

For use by War and Navy Department Agencies only
Not for sale or distribution

LEYTE ISLAND

SECOND EDITION-AMS 2

NC 51-3

SAMAR AND LEYTE (P.I.)



A.M.S. 5401
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.
Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941; USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 1936; 4422, 1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1915. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map of Portion of Samar Islands, 1:63,360, O. C. E. Q. Phil. Div., No. 1, 1908. Standard Recon. Map, Surigao & Agusan, 1:100,000, Inc. Co., No. 1. Vols. I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobilcil Road Map of the P. I., 1:1,100,000. Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000. USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000. Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Hq. Mil. Int., Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

CONVERSION GRAPH
NOT at the scale of the map.
Meters / Feet

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
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- City or Large Town
- Small Town
- Village or Settlement
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove

MANILA
DAVAO
Tagum
Peña
Kalan

Scale 1:500,000
10 8 6 4 2 0 10 20 Miles
10 8 6 4 2 0 10 20 30 Kilometers
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1° INCREASE
Do not use diagram except to obtain numerical value of angles

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1/2/1944
9-44

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

70

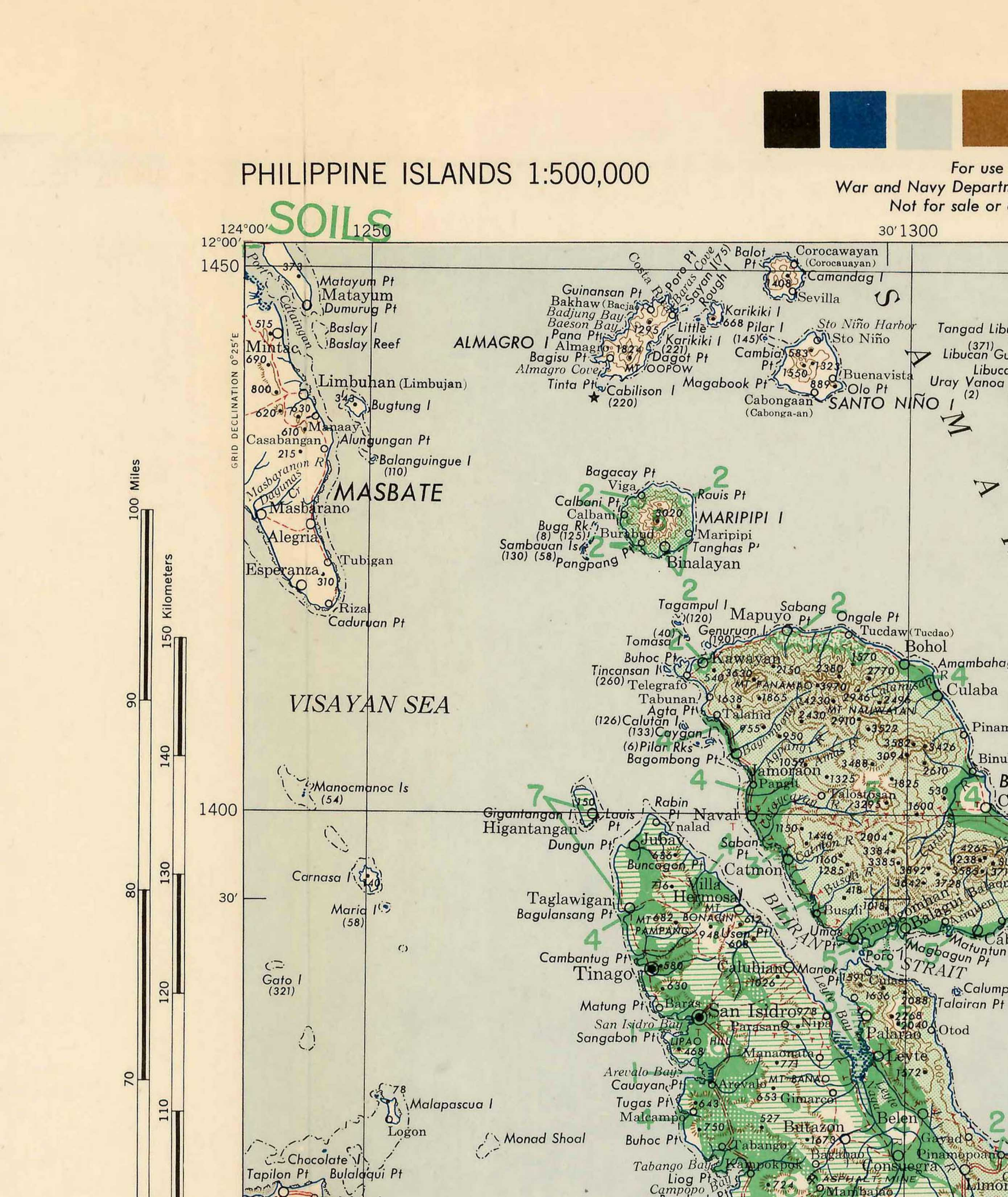
[redacted]

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

PHILIPPINE ISLANDS 1:500,000

SOILS

For use
War and Navy Departm
Not for sale or



[redacted]

by
ment Agencies only
distribution

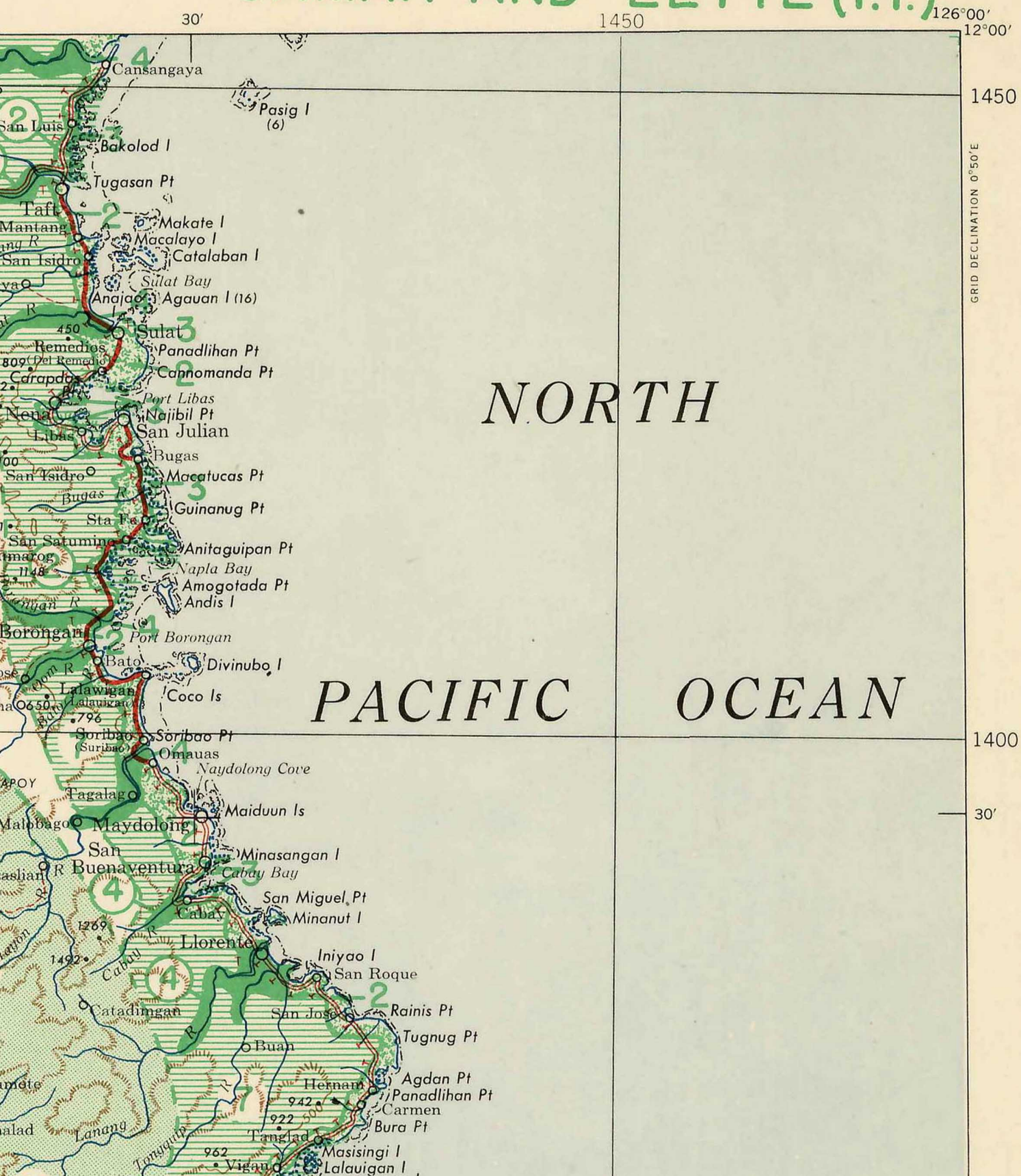
LEYTE ISLAND

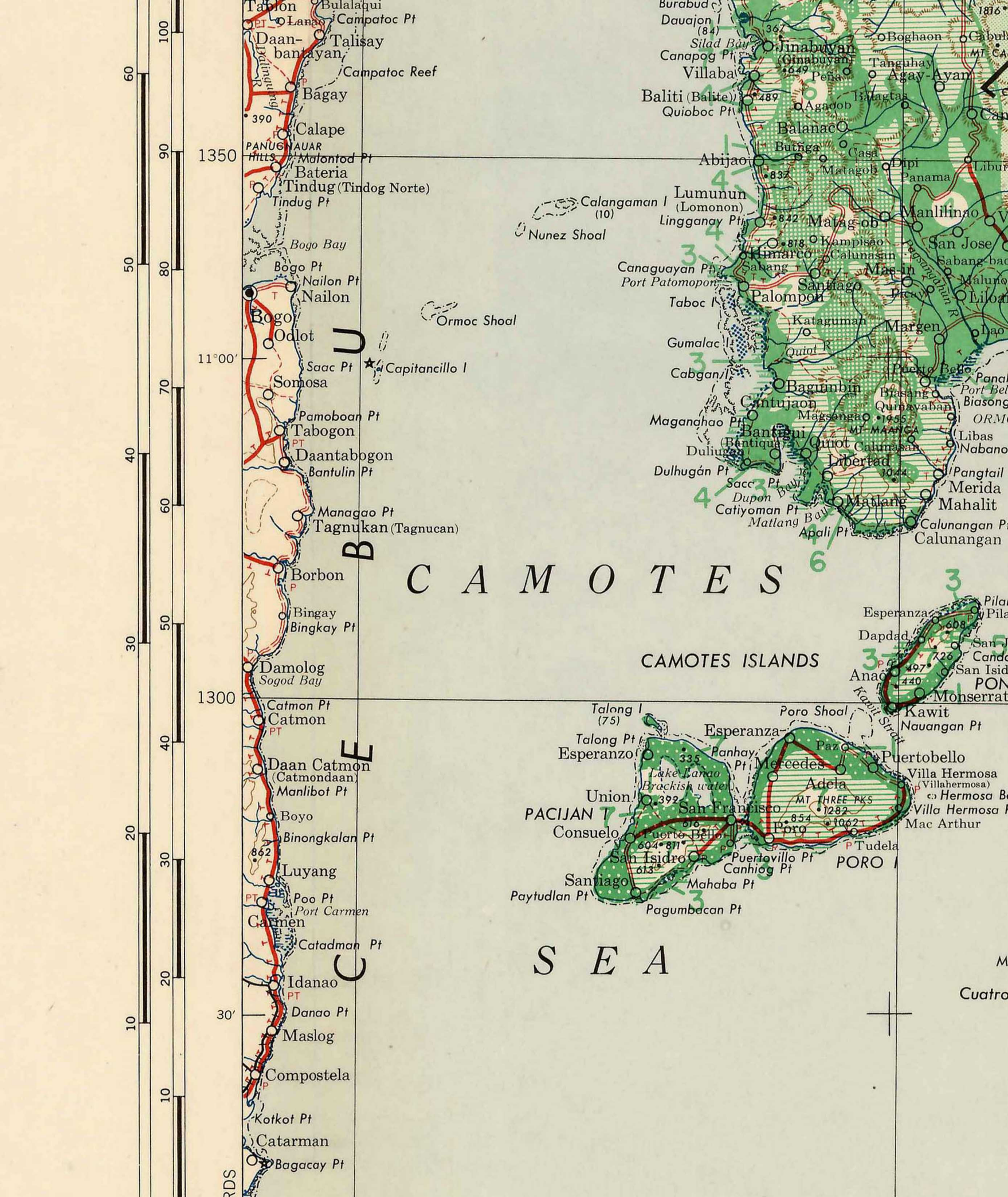

1350
125°00'
1400
Catbalogan
Wright
Motiong
Inalad
Loquilocon
Hinabangan
Calbiga
Villareal
San Fernando
Lale
Monoc
Jubasan
Buluan
Abaca
Patong
Calaya-an
Tinambac
Quinapondan
Guiuan
Mercedes
Salcedo
Balangiga
Giporlos
Borongan
Taft
Oras
Dolores
Arteche
Maslog
Can-ilay
Hinica-an
Catmon
Calape
Paco
Tulay
Balagon
Barayan
Cagcacalac
Tubig
Bagacay
Agamham
Masina
Cambamtoy
Laua-an
Malino
San Fernando
Tatubigan R
Lolugayan
Albalate
Hernandez
Palencia
Moroporo Pt
Irongirong Pt
Canahauan Daco I
Canahauan Gutiay I
Boloang I
Batgongon I
Bolo Rk
Cambaloi I
Ari I
Cagdullon
Buri I
Anas Pt
Lutao Reefs
Malubago
Jiabong Pt
Pangdan
Madalond Pt
Maqueda Bay
Malutugaui I
Longeb Pt
Majaba I
Basiao Is
San Sebastian
Jitaasim
Hita-asan
Gaang Pt
Marapilit I
Poro I
Pasigay
Villareal Bay
Quindoc I
Tingo
Buaya
Guintarcan
Baclayan
Lamingao I
Banquel
Aocon Is
Sua
Naparican Pt
Bakhaw Pt
Badian I
Bugacay
Mabini
Olayan
Burgos
Calubian Pt
Bacsal Is
Daram Channel
Talalora
Planderl
Bino-ongan
Dulugdug Pt
Nabatas Pt
Diutay Pt
Malagining Pt
Janabatas Channel
Sta Rita
Tomandog (Anibongon)
Anibuangan Eduardo
Manunca
Calaguan I
Canguay I
Dabun I
Baluarte Pt
Kalangawan
Nabung Cove
Navahay I
Caltagan I
Tandayan Pt
Bacod
Babatngon
La Paz
Bagalibas (Bagolibas)
Pinogahan
Malibago
Sta Cruz
Banug Pt
San Isidro
Uban Pt
Sta Elena
Buenavista
Balayon
Soholton
New San Agustan
Mongabong
Burgos
Nouvlas
Basey
Oce
Magallanes
Nouvlas
Kabalawan (Cabalawan)
Tinaogan
San Miguel
Lukay
Amahit
Barugo
Calingcaguing
Carigara
Culasian Pt
Impo
Duka
Ibug Lake
Sapanton R
Busay R
Bagahupi Peak
2003
MT BUSAY
1830
MT SOHOTON
MT ASGAD
MT CABALANTIAN
2654
MT CAPUTIAN
1926
MT CANTOMAY
2196
MT YACGEM
1496
MT BIHAG
MT MACTAON
MT CATALUTUAN
MT PASAYAHON
1177 DANGLAY
613 MT
Sorbar R
Balangiga R
Big R
Ulut R
Catbalogan R
Calbiga R
Basey R
Sta Cruz R
Tubig R
Lukay R
Tinaogan R
Lanang R
Lanang Pt
Lanang Bay
Tarangnan Bay
Cambalutay Bay
Erong Bay
Buad Channel
Dormirt Bay
Batubaruy Bay
Canauayan Bay
Sumuhit Bay
Zumarraga Bay
Batairo Bay
Nabung Cove
Daram Channel
Janabatas Channel
Lihong Bay
Sua Bay
Villareal Bay
Buad I
Zumarraga
Daram
Tarangnan
Libucan
Pagsanjan
Pagsanghan
Dapdap
Bangon I
Cambay I
Goyam I
Napalisan Is
Caprangasan
Caprangasan I
Sondara I
Concepcion
San Luis
S Jorge
Bulao
Blanca Aurora
Cantaguic
Janipon
Sta Cruz
Tagdaranao
Lunod Rk
Laylaya Is
Dapdap Rks
Tangad I
Borobaloto Rk
Timpasan I
Canahauan Islands
Balading I
Sierra
Batgongon I
Mangcares Pt
Canawayan Is
Canmamot Is
Cambidsos Rks
Ginlantuyan Pt
Astorga
Birauan
Halaba Pt
Yagbungan Pt
Patabunan Rf
Sumuhit Pt
Cabitunang Pt
Danaodanauan I
Malayoc Pt
Cahuayan Pt
Taratara
Rizal
Parasan
Tinaogan Pt
Darajuay I
Little Darajuay I
Reefs
South Channel
North Channel
Lutao
Anas Pt
Buri
Buri I
Cagdullon
Ari I
Balading I
Cambaloi I
Bolo Rk
Batgongon I
Boloang I
Canahauan Gutiay I
Canahauan Daco I
Irongirong Pt
Moroporo Pt
Canmamot Is
Mangcares Pt
Canawayan Is
Laylaya Is
Dapdap Rks
Tangad I
Borobaloto Rk
Timpasan I
Libucan I
Ravis Pt
Goyam I
Bangon I
Cambay I
Caprangasan I
Caprangasan
Napalisan Is
Sondara I
Concepcion
San Luis
S Jorge
Bulao
Pagsanjan
Pagsanghan
Dapdap
Blanca Aurora
Cantaguic
Janipon
Sta Cruz
Tagdaranao
Lunod Rk

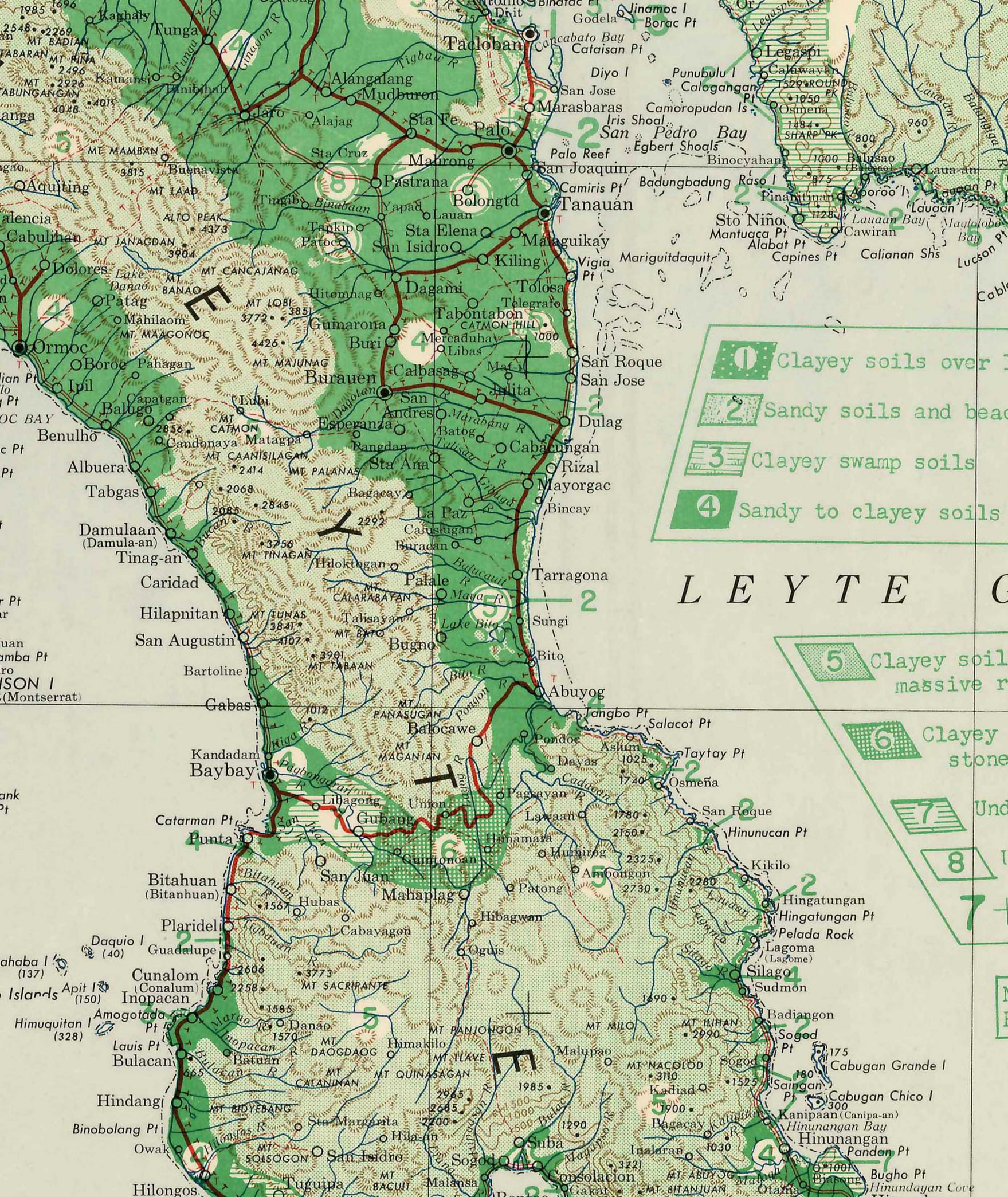
SECOND EDITION-AMS 2

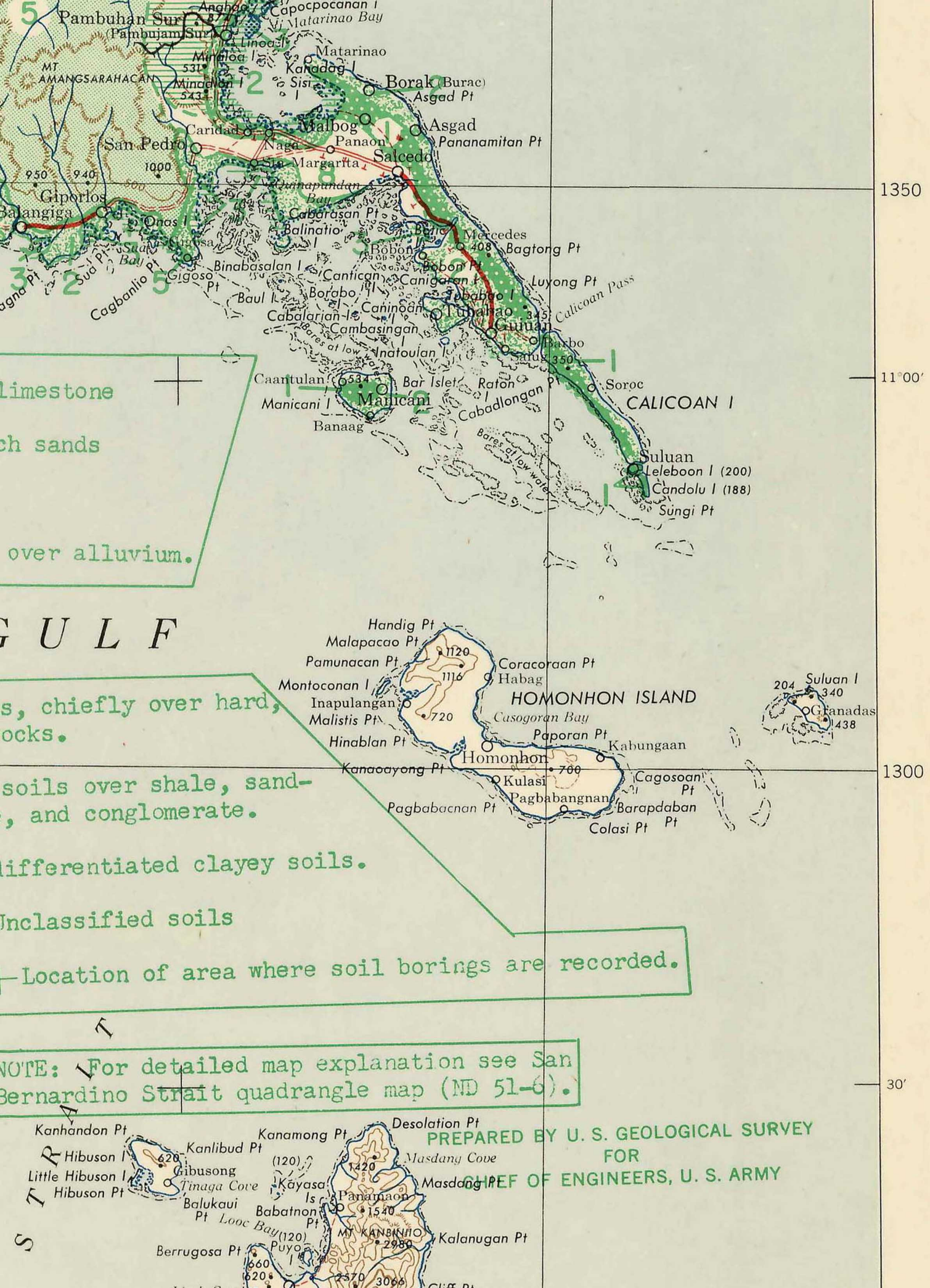
NC 51-3

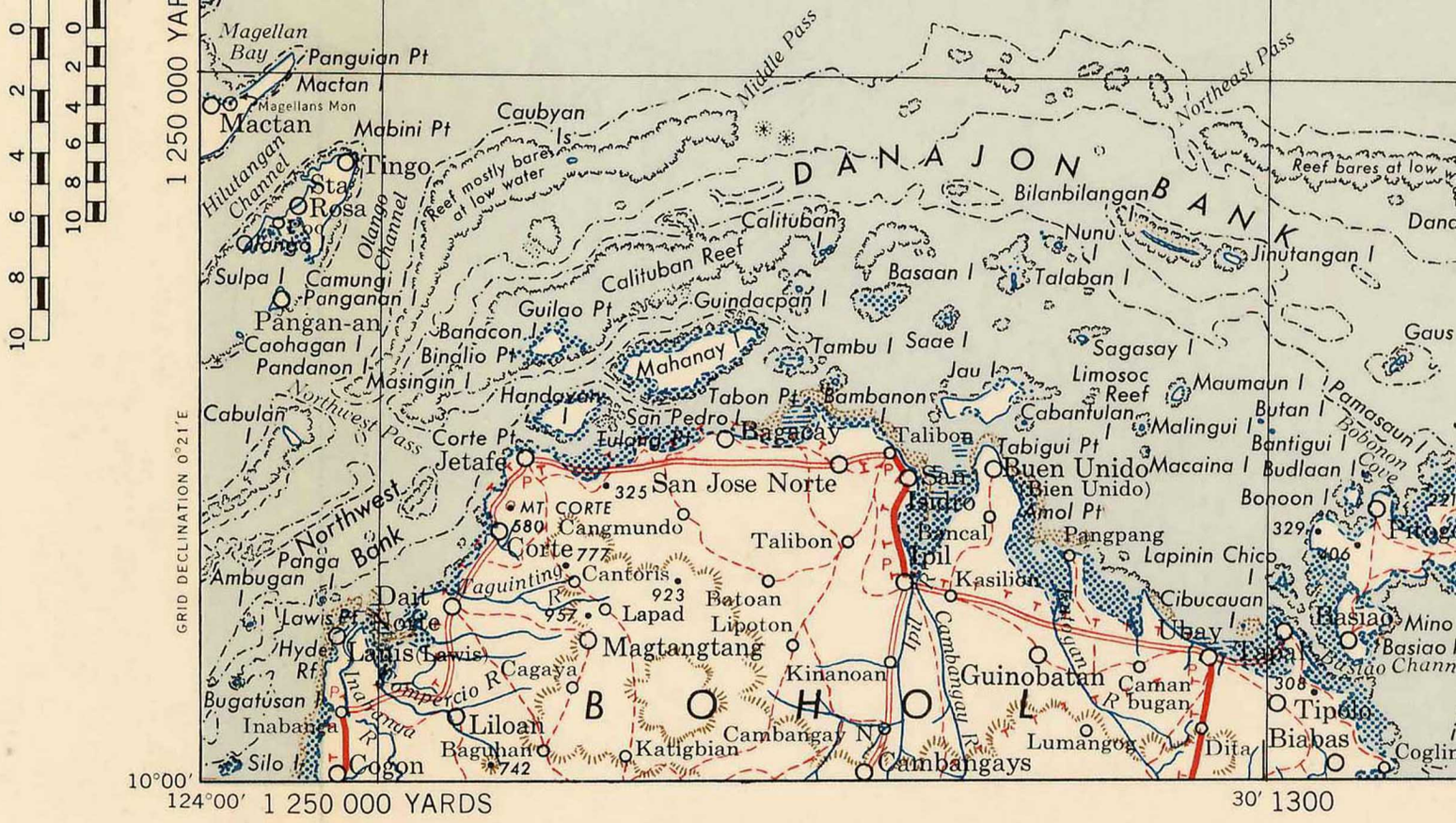
SAMAR AND LEYTE (P.I.)




Tabion
Bulalaqui
Lanao
Campatoc Pt
Daan-bantayan
Talisay
Campatoc Reef
Bagay
Calape
PANUGNAUAR Hills
Malontod Pt
Bateria
Tindug (Tindog Norte)
Tindug Pt
Bogo Bay
Bogo Pt
Nailon Pt
Nailon
Bogo
Odlot
Saac Pt
Capitancillo I
Somosa
Pamoboan Pt
Tabogon
Daantabogon
Bantulin Pt
Managao Pt
Tagnukan (Tagnucan)
Borbon
Bingay
Bingkay Pt
Damolog
Sogod Bay
Catmon Pt
Catmon
Daan Catmon (Catmondaan)
Manlibot Pt
Boyo
Binongkalan Pt
Luyang
Poo Pt
Port Carmen
Carmen
Catadman Pt
Idanao
Danao Pt
Maslog
Compostela
Kotkot Pt
Catarman
Bagacay Pt
Ormoc Shoal
Calangaman I (10)
Nunez Shoal
Canaguayan Pt
Port Patomopon
Taboc I
Gumalac
Cabgan I
Maganahao Pt
Duliugan
Dulhugán Pt
Sacc Pt
Dupon Bay
Catiyoman Pt
Matlang Bay
Apali Pt
Talong I (75)
Talong Pt
Esperanzo
Union
PACIJAN I
Consuelo
San Isidro
Santiago
Paytudlan Pt
Pagumbacan Pt
Lake Danao
Brackish water
Panhay Pt
Mahaba Pt
Puertovillo Pt
Canhiog Pt
Tudela
PORO I
Poro Shoal
Kawit
Nauangan Pt
Esperanza
Mercedes
Paz
Puertobello
Villa Hermosa (Villahermosa)
Adela
MT. THREE PKS
Mac Arthur
Poro
Puerto Bello
Burabud
Dauajon I (84)
Silad Bay
Canapog Pt
Villaba
Jinabuyan (Ginabuyan)
Baliti (Balite)
Quioboc Pt
Agadob
Balanac
Butnga
Abijao
Lumunun (Lomonon)
Lingganay Pt
Himarco
Sabang
Santiago
Palompon
Kataguman
Margen
Quiot R
Bagumbin
Cantujaon
Bantigui (Bantique)
Quiot
Libertad
Matlang
Mahalit
Calunangan
Boghaon
Tangulhay
Agay-Ayan
Balagtas
Casa
Matagob
Panama
Kampisao
Calunasan
Mac-in
Pagsangahan R
San Jose
Sabang-bac
Maluno
Liloa
Margen
Biasong
Quinayabang
Magsongao
MT. MAANGA
Libas
Nabano
Pangtail
Merida
Mahalit
Calunangan
CAMOTES ISLANDS
Esperanza
Dapdad
Anao
Monserrat
Cando
San Isid
PON
CAMOTES
SEA
Cuatro
1350
1300
11°00'
30'


1 Clayey soils over
2 Sandy soils and bea
3 Clayey swamp soils
4 Sandy to clayey soils
5 Clayey soil
massive r
6 Clayey
stone
7 Und
8
LEYTE
Tacloban
Legaspi
Tanauan
Palo
Marasbaras
Tunga
Kaghaly
Alangalang
Mudburon
Jaro
Alajag
Sta Fe
Sta Cruz
Mahrong
Pastrana
Bolongtd
Aquiting
Cabulihan
Dolores
Patag
Mahilaom
Ormoc
Boroc
Pahagan
Ipil
Capatgan
Balugo
Benulho
Albuera
Tabgas
Damulaan
(Damula-an)
Tinag-an
Caridad
Hilapnitan
San Augustin
Bartoline
Gabas
Kandadam
Baybay
Catarman Pt
Punta
Bitahuan
(Bitanhuan)
Plaridel
Cunalom
(Conalum)
Inopacan
Amogotada Pt
Bulacan
Hindang
Binobolang Pt
Owak
Hilongos
Tuguipa
San Isidro
Sta Margarita
Hila-an
Sogod
Consolacion
Malansa
Gakat
Mt Bitanjuan
Otama
Hinundayan Cove
Bugho Pt
Kanipaan (Canipa-an)
Hinunangan
Hinunangan Bay
Pandan Pt
Cabugan Grande I
Cabugan Chico I
Saingan Pt
Sogod Pt
Badiangon
Sudmon
Silago
Lagoma
(Lagome)
Pelada Rock
Hingatungan
Hingatungan Pt
Kikilo
San Roque
Hinunucan Pt
Taytay Pt
Osmeña
Salacot Pt
Tangbo Pt
Abuyog
Bito
Sungi
Tarragona
Mayorgac
Rizal
Dulag
Julita
San Jose
San Roque
Tolosa
Tabontabon
Kiling
Malaguikay
Tanauan
Sto Niño
Cawiran
Laua-an
Lauaan I
Lauaan Bay
Lauaan Pt
Binocyahan
San Joaquin
Palo Reef
Egbert Shoals
San Pedro Bay
Iris Shoal
Camoropudan Is
Punubulu I
Calogangan Pt
Osmena
Calubayan
Diyo I
San Jose
Godela
Jinamoc I
Borac Pt
Cancabato Bay
Cataisan Pt
Dait
Binatac Pt
Mariguitdaquit I
Vigia Pt
Camiris Pt
Badungbadung
Raso I
Pinanitunan
Mantuaca Pt
Alabat Pt
Capines Pt
Calianan Shs
Lucson Pt
Dagami
Burauen
Calbasag
San Andres
Esperanza
Matagpa
Candonaya
Lubi
Ormoc Bay
Leyte Gulf
Carigara Bay
Mt Cancajanag
Mt Majunag
Mt Catmon
Mt Caanisilagan
Mt Palanas
Mt Lobi
Mt Maagonoc
Mt Janagdan
Mt Mamban
Mt Laad
Alto Peak
Lake Danao
Mt Banao
Mt Lunas
Mt Tinagan
Mt Calarabayan
Mt Panaosugan
Mt Maganian
Mt Sacripante
Mt Daogdaog
Mt Quinasagan
Mt Calanunan
Mt Bidyebang
Mt Soisogon
Mt Panjongon
Mt Ilave
Mt Milo
Mt Ilihan
Mt Nacolod
Mt Bacuit
Catmon Hill
Sharp Pk
Bugtong Bato
Lauaan R
Cadacan R
Pagsayan R
Maya R
Lake Bito
Bito R
Pongon R
Pagbongbongan R
Mahaplag
Hubas
Cabayagon
Guadalupe
Oguis
Hibagwan
Patong
Himamara
Humirog
Ambongon
Guintonoan
Union
Gubang
Libagong
Lawaan
Pagsanjan
Aslum
Dayas
Pondoc
Balocawe
Bugno
Talisayan
Palale
Buracan
Caluluguan
La Paz
Bagacay
Batog
Rangdan
Sta Ana
Hiloktogan
Tigbao R
Tungod R
Cinagon R
Binabaan
Yapad
Lauan
Tingib
Tankip
Patoc
Sta Elena
San Isidro
Hitomhag
Gumarona
Buri
Mercaduhay
Libas
Telegrafo
Mat-i
Pahagan
Lubi
Matagpa
Rangdan
Sta Ana
Bagacay
Buracan
Caluluguan
La Paz
Palale
Talisayan
Bugno
Bito
Abuyog
Tangbo Pt
Salacot Pt
Pondoc
Aslum
Dayas
Taytay Pt
Osmeña
Pagsanjan
Lawaan
San Roque
Hinunucan Pt
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Saingan Pt
Cabugan Chico I
Kanipaan
Hinunangan
Hinunangan Bay
Pandan Pt
Bugho Pt
Inalaran
Bagacay
Kadiad
Malupao
Suba
Sogod
Consolacion
Gakat
Otama
Hinundayan Cove
Mt Bitanjuan
Mt Abuyog
Mt Nacolod
Mt Milo
Mt Ilihan
Mt Panjongon
Mt Ilave
Mt Daogdaog
Mt Quinasagan
Mt Calanunan
Mt Bidyebang
Mt Soisogon
Mt Bacuit
Mt Sacripante
Mt Tinagan
Mt Calarabayan
Mt Panaosugan
Mt Maganian
Mt Lunas
Mt Tabaan
Mt Catmon
Mt Majunag
Mt Maagonoc
Mt Janagdan
Mt Cancajanag
Mt Lobi
Mt Banao
Mt Mamban
Mt Laad
Alto Peak
Lake Danao
Catmon Hill
Sharp Pk
Bugtong Bato
Lauaan R
Cadacan R
Pagsanj


Pambuhan Sur
(Pambujan Sur)
Anghad
Capocpocanan I
Matarinao Bay
Linoan I
Matarinao
Minaloa I
Kanadag I
MT AMANGSARAHACAN
Minaloan I
Sisi I
Borak (Burac)
Asgad Pt
Caridad
Malbog
Asgad
San Pedro
Nage
Panaon
Pananamitan Pt
Salcedo
Sta Margarita
Quinapundan Bay
Giporlos
Balangiga
Onas I
Cabarasan Pt
Balinatio I
Bobon
Mercedes
Bagtong Pt
Binabasalan I
Cantican
Canigaran I
Bobon Pt
Luyong Pt
Gigoso Pt
Cagbanlio Pt
Baul I
Borabo I
Caninoan
Tubabao I
Thalhao
Guiuan
Calicoan Pass
Cabalarian Is
Cambasingan
Bares at low water
Inatoulan I
Barbo
Salug
Caantulan
Bar Islet
Raton Pt
Soroc
CALICOAN I
Manicani I
Manicani
Cabadlongan Pt
Banaag
Suluan
Leleboon I (200)
Candolu I (188)
Sungi Pt
Handig Pt
Malapacao Pt
Pamunacan Pt
Coracoraan Pt
Habag
Montoconan I
Inapulangan
HOMONHON ISLAND
Malistis Pt
Casogoran Bay
Hinablan Pt
Paporan Pt
Kabungaan
Homonhon
Kanaoayong Pt
Kulasi
Cagosoan Pt
Pagbabacnan Pt
Pagbabangnang
Barapdaban Pt
Colasi Pt
Suluan I
Granadas
Kanhandon Pt
Hibuson I
Little Hibuson I
Hibuson Pt
Kanlibud Pt
Gibusong
Tinaga Cove
Balukaui Pt
Looc Bay
Kanamong Pt
Desolation Pt
Masdang Cove
Masdang Pt
Kayasa Is
Panamaon Pt
Babatnon Pt
MT KANBINIO
Kalanugan Pt
Berrugosa Pt
Puyo I
STRAIT
1350
11°00'
1300
30'
limestone
ch sands
over alluvium.
GULF
s, chiefly over hard,
ocks.
soils over shale, sand-
, and conglomerate.
ifferentiated clayey soils.
Unclassified soils
—Location of area where soil borings are recorded.
NOTE: For detailed map explanation see San
Bernardino Strait quadrangle map (ND 51-6).
PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY



A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

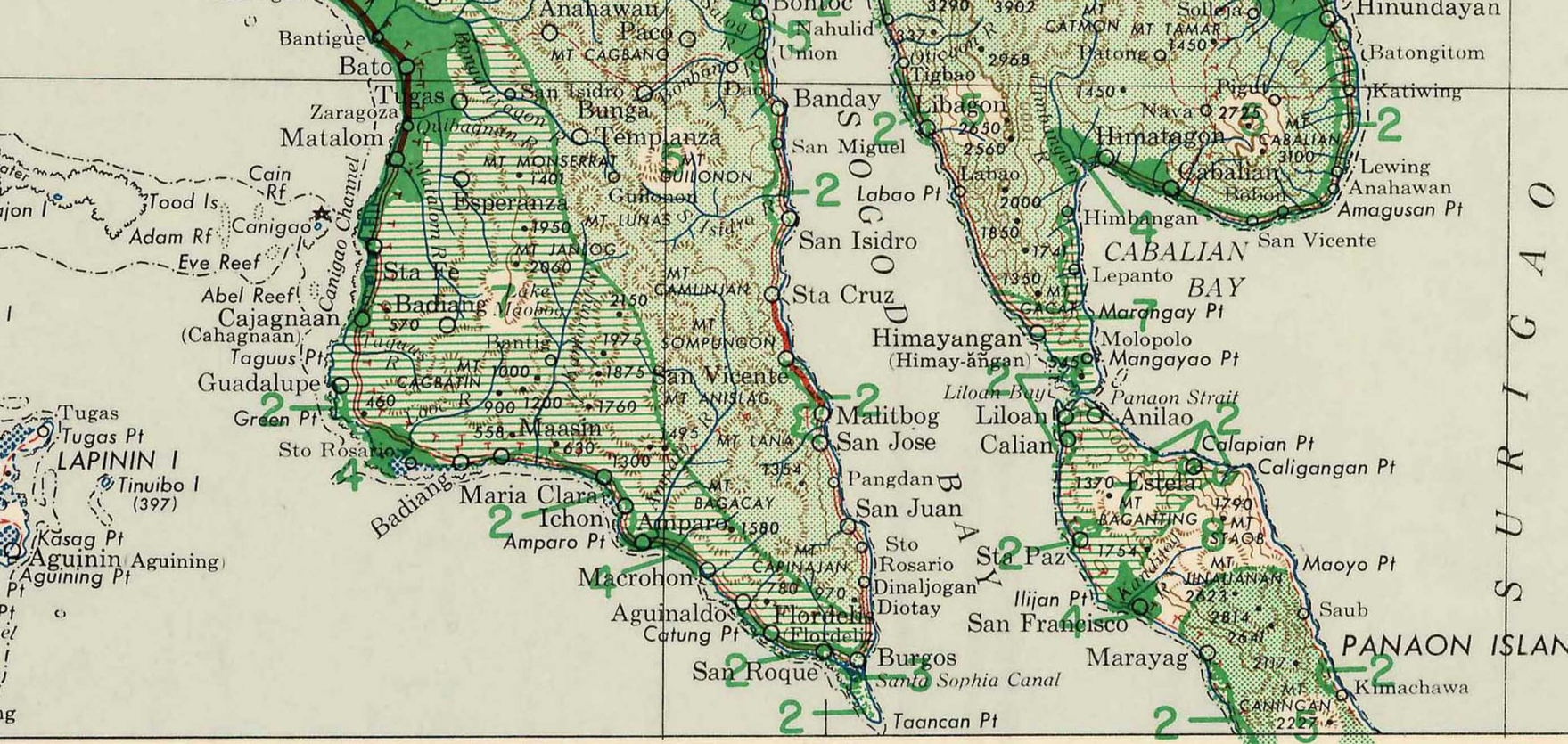
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D.
Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 19
1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippine
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I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road M
P. I., 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road M
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Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, U
No. 100, 1933.

CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
500	2,000
	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove



C., 1944.
86; 4422,
Islands,
Portion of
. 1. Vols.
Map of the
ap of the
Mil. Int.,
USC & GS,

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

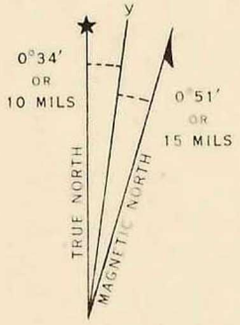
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS WASHINGTON, D. C.



APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

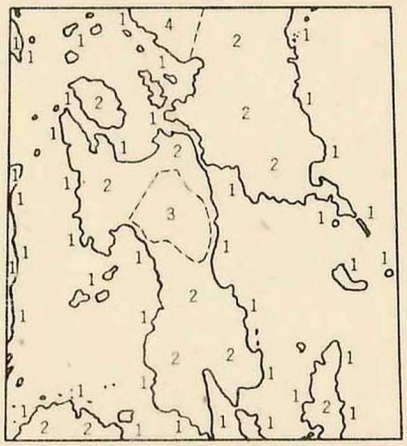


HEIGHTS IN FEET AND DEPTHS IN FATHOMS

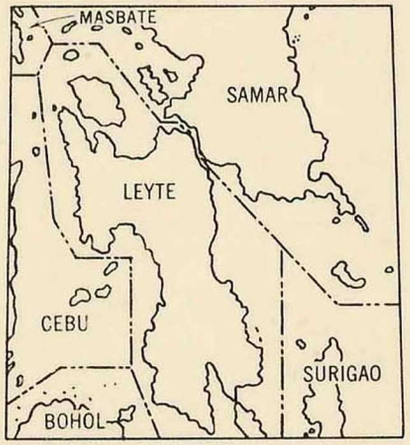


ARMY MAP SERVICE, U S ARMY, WASHINGTON D. C. 112094
9-44 1944

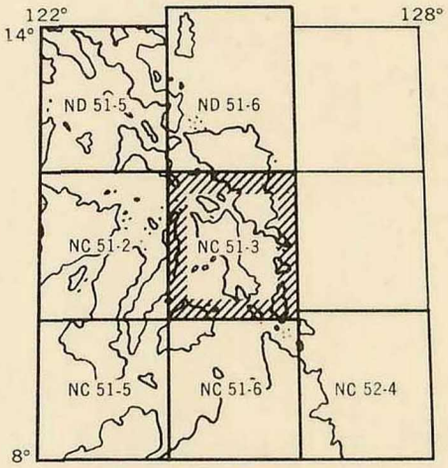
COVERAGE DIAGRAM



INDEX TO BOUNDARIES



INDEX TO ADJOINING SHEETS



1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

Reliability: Poor

INTRODUCTION

General Statement

Only scant information is available concerning the soils on Leyte and Samar; hence the accompanying soil maps are based almost entirely upon meager information concerning the geology, topography, natural vegetation and climatic conditions of the region.

The soils are developed from limestone, sandstone, shale, conglomerate, and a variety of other rock types.

Much of Leyte is characterized by hilly to steep land, but there is a nearly level to undulating lowland belt in the northeastern portion of the island and a similar but discontinuous, belt bordering the coast. Altitudes range from over 4,000 feet on a few mountain peaks in north central Leyte to about 1,500 to 3,000 feet on the rest of the uplands. Altitudes at most places on the lowland belts are probably less than 100 feet.

On Samar, the land is hilly to steep and in most places altitudes range from 1,000 to 1,500 feet. The highest mountain, which is in north central Samar, has an altitude of less than 2,800 feet. A low discontinuous plain varying in width from one to three miles fringes most of the coast.

The average annual temperature on both Leyte and Samar is approximately 80°F. Average annual rainfall varies from 165 inches on portions of the east coast of Samar to 86 inches at Ormoc on the west coast of Leyte. There is no well-defined dry season.

Owing to the warm temperature and high rainfall, decomposition of the rocks is rapid and on gentle slopes has proceeded to depths of many feet. Climatic conditions also favor the accumulation of iron and alluminum oxides and the removal of soluble silica from the soil.

As a result of climatic conditions, soils developed from limestones and various dark-colored hard rocks, are characterized by red to brown colors, clayey textures, friable consistence, granular structure, only slight changes in volume with moisture changes, acid reaction, and low content of organic matter. In their natural conditions these soils are porous and easily permeable to water, but if worked under wet conditions they become sticky, and plastic. On hilly to steep land they are much shallower than on gently sloping land in many places are less than 35 inches in total depth. The above characteristics are typical of some soils (a) in Map Unit 1, soils in Map Unit 5, and a considerable part of the soils in Map Unit 7.

On limestone benches and on impure limestones of higher areas the soils are shallow, plastic, usually dark colored, and moderately high in organic matter. These characteristics are typical of some soils (b) in Map Unit 1. Soils with these characteristics are of minor importance; they comprise a small proportion of Map Unit 1.

Soils developed on shales and sandstones are generally yellowish brown or reddish brown. Those on shales are shallower, more plastic, and have greater volume changes than those developed from other rock types. They remain wet and plastic for longer periods following rains than the red to brown soils in Map Units 1 and 5. These soils are found in Map Unit 6 and make up a considerable part of Map Unit 7.

Soils developed from alluvial materials vary in color from gray to brown or yellow. They are commonly clayey textured, relatively impervious or only slowly pervious to water, and dry out slowly following rainy periods. They are found chiefly in Map Unit 4.

Poorly drained soils of Map Unit 3 occur as discontinuous narrow bands bordering the coast and sluggish streams.

Loose beach sands and sandy soils of the coastal plains are included in Map Unit 2. They are generally well drained, and dry quickly following rains; but in some places include narrow bands of poorly drained soil covered by dense mangrove or fresh-water swamp vegetation.

In the following table, phyiscal and chemical properties of the various soils are given. Because of tropical-climate conditions, properties of some soils differ from those of the same soils in temperate regions.

On the accompanying soil map the approximate boundaries between map units are shown by solid lines and indefinite boundaries are indicated by broken lines. However, it should be emphasized that owing to the lack of available information concerning the soils the limits of various map units may vary widely from the boundaries as indicated on the soil map. The generalized soil descriptions are thought to be representative of the dominant soils of the various map units but it must be emphasized that wide variations exist in soil conditions within each unit.

Definitions

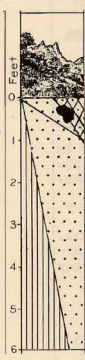
Surface Soil: The uppermost soil layer in which the majority of the plant feeder roots are located. This layer is of greater fertility and generally higher in organic matter than the subsoil.[a]

Subsoil: That part of the soil below the surface soil. It varies from a few inches to many feet in depth and is usually more clayey than the surface soil. It may contain considerable amounts of rock rubble and may grade into more or less rotten rock.

Granular: This is a structural term that refers to hard to soft, but firm, small aggregates of sand, silt, and clay.

Slope classification:
Level or hummocky land: Slopes of 0 to 3% predominate
Gently sloping to undulating land: Slopes of 3 to 8% predominate
Sloping to rolling land: Slopes of 8 to 15% predominate
Hilly land: Slopes of 15 to 30% predominate
Steep land: Slopes of greater than 30% predominate.

Map Unit 1: Clayey soils over limestone



(a) Shallow to deep granular, friable, soils of uplands.

Surface Soil: Brown to red granular, friable clay loam to clay, slightly darkened with organic matter. May contain fragments and outcrops of limestone. 0 to 12 inches thick average about 8 inches.

Subsoil: Brown to red friable, granular, permeable stony clay which in places contains iron concretions in the lower part of the layer. 0 to 35 inches thick on hilly to steep land, but many feet thick on undulating areas and in depressions.

Parent Rock: Thin-bedded to massive limestone bedrock.

Variations: Soil varies widely in depth and is absent on escarpments and higher limestone ridges. Includes bands of alluvial soils bordering streams.

Topography: Mostly hilly to steep; a few nearly level areas.

Drainage: Excellent surface and internal drainage under natural conditions.

Vegetation[b]: Chiefly broad-leafed forest, some secondary forest and cogon grass areas. Some areas used for abaca (manila hemp) and other planted crops.

Chemical Properties: High in iron and alumina. Generally acid. Low to only moderate fertility.

Group Symbol[c]: CL; A-4, A-6.

Consistence and Structure: Granular and friable when dry.

Cohesion, Permeability and Volume Changes: Low cohesion, permeable. Subject to only small changes in volume.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

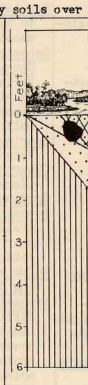
Grading: Requires heavy grading and some cutting or blasting or rock.

Foundation Properties[d/e]: Fair to Poor.

Value as a Base Directly Under Wearing Surface[e]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.



(b) Shallow plastic soils of terraces and uplands.

Surface Soil: Brown to dark-brown granular, friable to plastic clay loam or clay. Generally moderately high in organic matter. In places contains fragments of limestone. 0 to 10 inches thick, average about 6 inches.

Subsoil: Brown to dark brown plastic stony clay. 0 to 10 inches thick.

Parent Rock: Coral or soft impure limestone bedrock.

Variations: Chiefly in drainage, depth of soil, organic content and color. Soil is generally shallow. Includes a few narrow bands of alluvial soils along streams.

Topography: Nearly level to steep.

Drainage: Under natural conditions surface soil is permeable to water but impermeable when compacted when wet. Subsoil varies from well to poorly drained depending upon the amount of seepage and the topography; becomes temporarily impervious when worked while wet.

Vegetation[b]: Variable forest or grass cover. Some coconut palms.

Chemical Properties: Acid to limy. Higher in fertility but lower in iron and alumina than the red soils (a).

Group Symbol[c]: CH; A-6, A-7.

Consistence and Structure: Granular and friable when dry.

Cohesion, Permeability, and Volume Changes: Medium to high cohesion. Moderately permeable to impermeable. Large changes in volume on wetting and drying.

Bearing Ratio at Optimum Compaction: Poor.

Clearing: Requires clearing.

Grading: Requires light to heavy grading and considerable rock cutting or blasting.

Foundation Properties[d/e]: Poor to very poor. Clayey covering shallow (generally less then 20 inches) over limestone.

Value as a Base Directly Under Wearing Surface[e]: Not suitable.

Mechanical Stabilization: Same method should be used as with 1 (a) but it is more difficult to stabilize.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 2: Loose beach sand and sandy soils of coastal plains



(a) Loose beach sands.

Surface Soil: Yellowish gray sands or gravelly sands; depth 36 inches or more.

Subsoil: Same as surface soil; overlies great depth of mixed alluvium.

Parent Rock: Sand; bedrock at various depths.

Variations: Chiefly in stability and elevation.

Topography: Nearly level or hummocky to undulating beaches. Dunes in some places.

Drainage: Good to excellent surface and internal drainage.

Vegetation[b]: Open forest, grass cover, or coconut groves.

Chemical Properties: Limy to acid. Low fertility.

Group Symbol[c]: GP, A-3; SP,A-3.

Consistence and Structure: Loose sand or gravel textures with very little clayey material. Range from non-sticky to slightly sticky and have single-grained structure.

Cohesion, Permeability and Volume Changes: Practically no cohesion. Very permeable. Subject only to very small changes in volume.

Bearing Ratio at Optimum Compaction: Fair to good; excellent if confined.

Clearing: Requires little clearing.

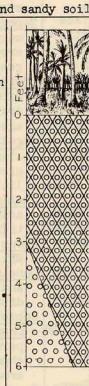
Grading: Requires no grading or only light grading. No rock cutting required.

Foundation Properties[d/e]: Fair to excellent. Generally unstable unless clayey materials are added or where the materials are confined.

Value as a Base Directly Under Wearing Surface[e]: Poor to good.

Mechanical Stabilization: Can be stabilized by ponding or by the addition of clayey materials (binder).

Suitability for Stabilization with Portland Cement or Bitumen: Good to excellent.



(b) Sandy soils of coastal plains.

Surface Soil: Pale-brown loamy sand or sandy loam or gravels. 3 to 10 feet thick.

Subsoil: Pale-yellow to yellowish-gray sand.

Parent Rock: Sandy deposits; bedrock at various depths.

Variations: Includes narrow depressions which contain poorly drained soils covered with mangrove or fresh-water swamp vegetation. Sands in part coral, in part quartz.

Topography: Nearly level to undulating.

Drainage: Good to excellent internal drainage.

Vegetation[b]: Open forest, grass, or planted crops. Planted areas are used chiefly for coconuts.

Chemical Properties: Acid to calcareous. Generally of low fertility.

Group Symbol[c]: SF,GF; A-2.

Consistence and Structure: Nearly structureless loamy sand to gravelly loam with sticky consistence due to the slight clay content.

Cohesion, Permeability, and Volume Changes: Good to excellent.

Clearing: Requires some clearing.

Grading: Requires no grading or only light grading. No rock cutting required.

Foundation Properties[d/e]: Fair to excellent foundation conditions.

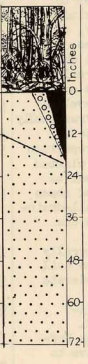
Value as Base Directly Under Wearing Surface: Good to unsuitable.

Mechanical Stabilization: Can be stabilized either by tamping or with smooth-faced rollers.

Suitability for Stabilization with Portland Cement or Bitumen: Fair to good.

Bearing Ratio at Optimum Compaction: Fair to good; excellent if confined.

Map Unit 3: Clayey swamp soils



Surface Soil: Medium- to light-gray, dense, plastic, very fine sandy clay, clay, muck or peat; 12 to 48 inches thick.

Subsoil: Medium-to light-gray dense plastic clay.

Parent Rock: Clayey deposits; bedrock at various depths.

Variations: Muck or peat areas are rare.

Topography: Low swampy coastal areas.

Drainage: Poor. In many places covered with water.

Vegetation[b]: Dense mangrove or fresh-water swamp vegetation.

Chemical Properties: Many areas are saline.

Group Symbol[c]: CH,A-7. OH; A-7,A-8.

Consistence and Structure: Plastic to very plastic with nearly massive structure.

Cohesion, Permeability and Volume Changes: High cohesion. Impermeable. Subject to moderate to high changes in volume.

Bearing Ratio at Optimum Compaction: Very poor to poor.

Clearing: Requires heavy clearing

Grading: Requires heavy fill, with reinforcement and piling, to raise roadbed above water level.

Foundation Properties[d/e]: Poor to very poor.

Value as Base Directly Under Wearing Surface[e]: Not suitable.

Mechanical Stabilization: Very difficult because of low position, poor drainage, and fine texture. Requires heavy tamping rollers. Surface aggregate must be added.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

[a] In airfield construction this layer may be stripped off and used in places where cover of grass or other plants desirable.
[b] For more detailed information, see Vegetation Sheet.
[c] Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
[d] Values are for subgrade and base courses except for base courses directly under wearing surface.
[e] Evaluation for guidance only. Design should be based on test results.

[redacted]

(continued)

SAMAR AND LEYTE(P.I.)

General Statement

Only scant information is available concerning the soils on Leyte and Samar; hence the accompanying soil maps are based almost entirely upon meager information concerning the geology, topography, natural vegetation and climatic conditions of the region.

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As a result of climatic conditions, soils developed from limestones and various dark-colored hard rocks, are

Reliability: Poor

INTRODUCTION

On limestone benches and on impure limestones of higher areas the soils are shallow, plastic, usually dark colored, and moderately high in organic matter. These characteristics are typical of some soils (b) in Map Unit 1. Soils with these characteristics are of minor importance; they comprise a small proportion of Map Unit 1.

Soils developed on shales and sandstones are generally yellowish brown or reddish brown. Those on shales are shallower, more plastic, and have greater volume changes than those developed from other rock types. They remain wet and plastic for longer periods following rains than the red to brown soils in Map Units 1 and 5. These soils are found in Map Unit 6 and make up a considerable part of Map Unit 7.

Soils developed from alluvial materials vary in color from gray to brown or yellow. They are commonly clayey textured, relatively impervious or only slowly pervious to water, and dry out slowly following rainy periods. They are found chiefly in Map Unit 4.

Poorly drained soils of Map Unit 3 occur as discontinuous narrow bands bordering the coast and sluggish streams.

Loose beach sands and sandy soils of the coastal plains are included in Map Unit 2. They are generally well drained, and dry quickly following rains; but in some places include narrow bands of poorly drained soil covered by dense mangrove or fresh-water swamp vegetation.

In the following table, phyiscal and chemical properties of the various soils are given. Because of tropical-climate conditions, properties of some soils differ from those of the same soils in temperate regions.

On the accompanying soil map the approximate boundaries between map units are shown by solid lines and indefinite boundaries are indicated by broken lines. How-

layer is of greater fertility and generally higher in organic matter than the subsoil.[a]

Subsoil: That part of the soil below the surface soil. It varies from a few inches to many feet in depth and is usually more clayey than the surface soil. It may contain considerable amounts of rock rubble and may grade into more or less rotten rock.

Granular: This is a structural term that refers to hard to soft, but firm, small aggregates of sand, silt, and clay.

Slope classification:

Level or hummocky land: Slopes of 0 to 3% predominate

Gently sloping to undulating land: Slopes of 3 to 8% predominate

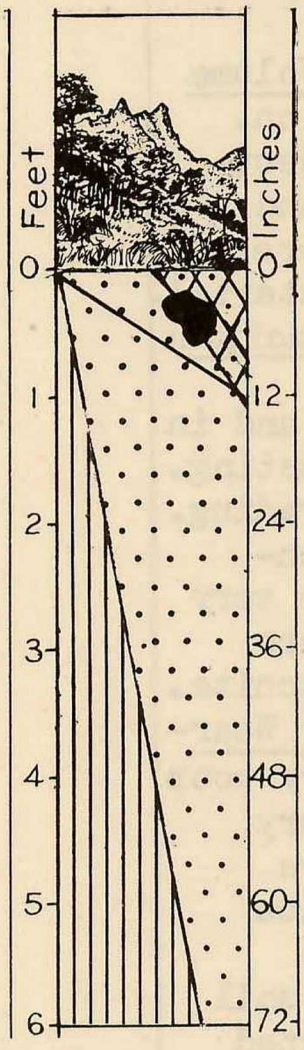
Sloping to rolling land: Slopes of 8 to 15% predominate

Hilly land: Slopes of 15 to 30% predominate

Steep land: Slopes of greater than 30% predominate.

characterized by red to brown colors, clayey textures, friable consistence, granular structure, only slight changes in volume with moisture changes, acid reaction, and low content of organic matter. In their natural conditions these soils are porous and easily permeable to water, but if worked under wet conditions they become sticky, and plastic. On hilly to steep land they are much shallower than on gently sloping land in many places are less than 35 inches in total depth. The above characteristics are typical of some soils (a) in Map Unit 1, soils in Map Unit 5, and a considerable part of the soils in Map Unit 7.

Map Unit 1: Clayey soils over limeston



(a) Shallow to deep granular, friable, soils of uplands.

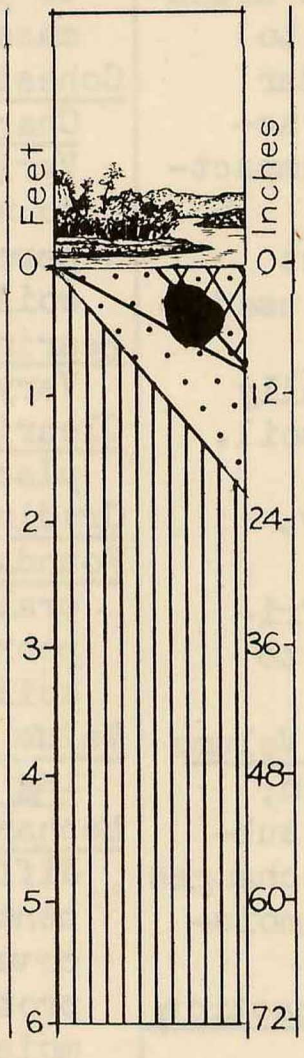
Surface Soil: Brown to red granular, friable clay loam to clay, slightly darkened with organic matter. May contain fragments and outcrops of limestone. 0 to 12 inches thick average about 8 inches.

Subsoil: Brown to red friable, granular, permeable stony clay which in places contains iron concretions in the lower part of the layer. 0 to 35 inches thick on hilly to steep land, but many feet thick on undulating areas and in depressions.

Parent Rock: Thin-bedded to massive limestone bedrock.

Variations: Soil varies widely in depth and is absent on escarpments and higher limestone ridges. Includes bands of alluvial soils bordering streams.

Topography: Mostly hilly to steep;



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Soil is generally
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Topography: Nearly

Drainage: Under na
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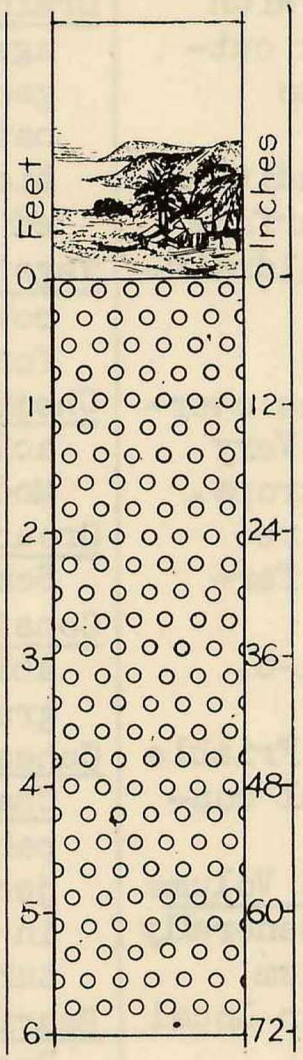
ever, it should be emphasized that owing to the lack of available information concerning the soils the limits of various map units may vary widely from the boundaries as indicated on the soil map. The generalized soil descriptions are thought to be representative of the dominant soils of the various map units but it must be emphasized that wide variations exist in soil conditions within each unit.

Definitions

Surface Soil: The uppermost soil layer in which the majority of the plant feeder roots are located. This

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Map Unit 2: Loose beach sand and sandy soils of c



(a) Loose beach sands.

Surface Soil: Yellowish gray sands or gravelly sands; depth 36 inches or more.

Subsoil: Same as surface soil; overlies great depth of mixed alluvium.

Parent Rock: Sand; bedrock at various depths.

Variations: Chiefly in stability and elevation.

Topography: Nearly level or hummocky to undulating beaches. Dunes in some places.

Drainage: Good to excellent surface and internal drainage.

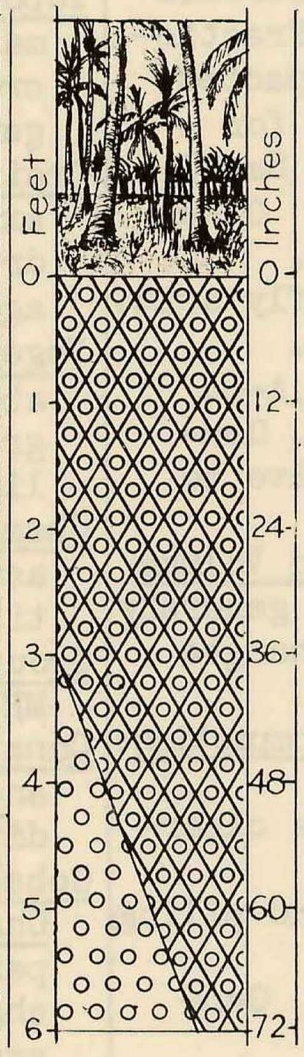
Vegetation[b]: Open forest, grass cover, or coconut groves.

Chemical Properties: Limy to acid. Low fertility.

Group Symbol[c]: GP, A-3; SP,A-3.

Consistence and Structure: Loose sand or gravel textures with very little clayey material. Range from non-sticky to slightly sticky and have single-grained structure.

Cohesion, Permeability and Volume



Drainage: Good t
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Vegetation[b]: Op
planted crops.
used chiefly f
Chemical Properti
careous. Gene
ity.
Group Symbol[c]:

coastal plains

b) Sandy soils of coastal plains.

urface Soil: Pale brown loamy sand or sandy loam or gravels. 3 to 10 feet thick.

ubsoil: Pale-yellow to yellowish-gray sand.

arent Rock: Sandy deposits; bedrock at various depths.

ariations: Includes narrow depressions which contain poorly drained soils covered with mangrove or freshwater swamp vegetation. Sands in part coral, in part quartz.

opography: Nearly level to undulating.

o excellent in-

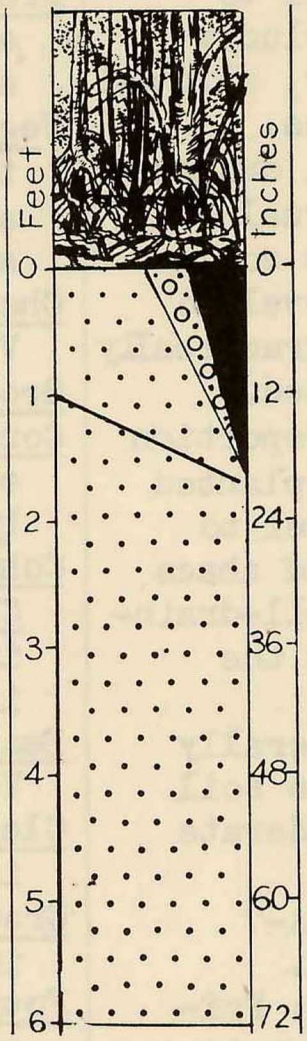
e.

en forest, grass, or Planted areas are or coconuts.

ies: Acid to cally of low fertil-

SF,GF: A-2.

Map Unit 3: Clayey swamp soils



Surface Soil: Medium- to light-gray, dense, plastic, very fine sandy clay, clay, muck or peat; 12 to 18 inches thick.

Subsoil: Medium-to light-gray dense plastic clay.

Parent Rock: Clayey deposits; bedrock at various depths.

Variations: Muck or peat areas are rare.

Topography: Low swampy coastal areas.

Drainage: Poor. In many places covered with water.

Vegetation[b]: Dense mangrove or freshwater swamp vegetation.

Chemical Properties: Many areas are saline.

Group Symbol[c]: CH,A-7. OH; A-7,A-8.

Consistence and Structure: Plastic to very plastic with nearly massive structure.

Cohesion, Permeability and Volume Changes: High cohesion. Impermeable. Subject to moderate to high changes in volume.

Bearing Ratio at Optimum Compaction:

a few nearly level areas.

Drainage: Excellent surface and internal drainage under natural conditions.

Vegetation[b]: Chiefly broad-leafed forest, some secondary forest and cogon grass areas. Some areas used for abaca (manila hemp) and other planted crops.

Chemical Properties: High in iron and alumina. Generally acid. Low to only moderate fertility.

Group Symbol[c]: CL; A-4, A-6.

Consistence and Structure: Granular and friable when dry.

Cohesion, Permeability and Volume Changes: Low cohesion, permeable. Subject to only small changes in volume.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires heavy grading and some cutting or blasting or rock.

Foundation Properties[d/e]: Fair to Poor.

Value as a Base Directly Under Wearing Surface[e]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

amount of seepage
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pervious when wor

Vegetation[b]: Varia
grass cover. Son

Chemical Properties
Higher in fertili
iron and alumina
soils (a).

Group Symbol[c]: CH;

Consistence and Str
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Cohesion, Permeabil
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Bearing Ratio at Op
Poor.

Clearing: Requires

Grading: Requires
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Foundation Properti
very poor. Claye
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over limestone.

Value as a Base Dir
ing Surface[e]: No

Mechanical Stabiliz
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Suitability for Sta
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s: Acid to limy.
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abilization with
or Bitumen: Un-

Changes: Practically no cohesion. Very permeable. Subject only to very small changes in volume.

Bearing Ratio at Optimum Compaction: Fair to good; excellent if confined.

Clearing: Requires little clearing.

Grading: Requires no grading or only light grading. No rock cutting required.

Foundation Properties[d/e/]: Fair to excellent. Generally unstable unless clayey materials are added or where the materials are confined.

Value as a Base Directly Under Wearing Surface[e/]: Poor to good.

Mechanical Stabilization: Can be stabilized by ponding or by the addition of clayey materials (binder).

Suitability for Stabilization with Portland Cement or Bitumen: Good to excellent.

Consistence and
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Cohesion, Permea
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Grading: Require
only light gra
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[a/] In airfield construction this layer may be stripped off and used in places where cover of grass or other plants desirable.
[b/] For more detailed information, see Vegetation Sheet.
[c/] Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
[d/] Values are for subgrade and base courses except for base courses directly under wearing surface.
[e/] Evaluation for guidance only. Design should be based on test result

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Structure: Nearly
loamy sand to gravel-
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rties[d/][e/]: Fair to
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Good to unsuitable.
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Stabilization with
t or Bitumen: Fair

Optimum Compaction:
cellent if confined.

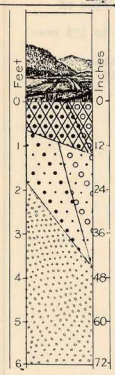
Very poor to poor.
Clearing: Requires heavy clearing
Grading: Requires heavy fill, with reinforcement and piling, to raise roadbed above water level.
Foundation Properties[d/][e/]: Poor to very poor.
Value as Base Directly Under Wearing Surface[e/]: Not suitable.
Mechanical Stabilization: Very difficult because of low position, poor drainage, and fine texture. Requires heavy tamping rollers. Surface aggregate must be added.
Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

ts.

(continued)

Reliability: Poor

Map Unit 4: Sandy to clayey soils over Alluvium



(a) Silt loams to sandy loams chiefly in lowland belt of northeastern Leyte.

Surface Soil: Light brownish gray to yellowish brown, slightly granular, and moderately friable silt loam to sandy loam, 8 to 15 inches thick

Subsoil: Yellowish brown or dusky yellow plastic silty clay to stiff impervious sandy clay 15 to 30 inches thick; overlies thick stratified deposits of sand, silt clay and gravel.

Parent Rock: Mixed alluvium.

Variations: Silty soils occur on the lower portions and sandy soils on the upper portions of alluvial fans and piedmont slopes At some places the soils have impervious, plastic, clayey subsoils (strongly developed clay pans). Includes small narrow bands of sandy well drained alluvial soils bordering streams.

Topography: Chiefly level to undulating land but includes narrow, in places hilly, alluvial fans and piedmont slopes.

Drainage: Generally well drained but may have slow internal drainage in some of the soils that occur on nearly level to gently sloping areas. Practically impervious when compacted.

Vegetation[b/]: A large proportion of this map unit is in planted crops. Rice on the level to gently sloping areas and abaca (manila hemp) on the well-drained, sloping uplands are the chief crops.

Chemical Properties: Generally acid in both the surface soil and subsoil. Low to moderate fertility.

Group Symbols[c/]: CH; A-6,A-7 Small amount of SF, A-2.

Consistence and Structure: Friable to plastic. Massive to blocky structure.

Cohesion, Permeability, and Volume Changes: Low to moderate cohesion. Permeable to impermeable; moderate changes in volume with moisture changes.

Bearing Ratio at Optimum Compaction: Fair to poor.

Clearing: Some areas require clearing.

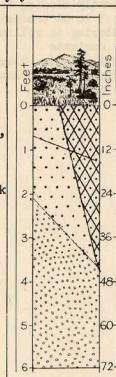
Grading: Requires moderate grading or fills.

Foundation Properties[d/e/]: Generally poor to very poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable

Mechanical Stabilization: Should be stabilized only under optimum moisture conditions. Should be compacted with heavy tamping rollers. Requires surface of aggregate for best results.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.



(b) Clay loams to clays: occur in the lowland belt of northeastern Leyte and as narrow bands bordering streams.

Surface Soil: Brown to gray stiff to plastic clay loam or clay. 10 to 15 inches thick.

Subsoil: Impervious, plastic clay loam or clay; pale brown or gray grading to light gray streaked with brown; 15 to 30 inches thick; overlies thick stratified deposits of gravel, sand, silt, or clay.

Parent Rock: Mixed alluvium; bedrock at various depths.

Variations: Narrow bands of sandy well-drained soils, bordering streams are generally well-drained; have good to excellent bearing ratio and foundation properties.

Topography: Chiefly level but includes some undulating land.

Drainage: Generally poor surface and internal drainage. Practically impervious when compacted.

Vegetation[b/]: Used chiefly for the production of rice. Small areas are in sugar cane. Other small areas are forested.

Chemical Properties: Chiefly acid. Varies from acid to limy.

Group Symbols[c/]: CH,A-7;CL,A-6.

Consistence and Structure: Generally plastic with massive to blocky structure.

Cohesion, Permeability, and Volume Changes: High cohesion; generally impermeable. Moderate changes in volume.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Some areas require clearing.

Grading: Requires fill and piling in low areas.

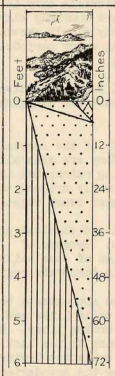
Foundation Properties[d/e/]: Generally poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized only under optimum moisture conditions.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 5: Clayey Soils chiefly over hard, massive rocks



Surface Soil: Reddish-brown, friable, granular clay loam or clay; stony in some places. Generally 4 to 6 inches thick but in places absent.

Subsoil: Brown to reddish-brown friable clay. 0 to several feet thick.

Parent Rock: Dark hard, massive rocks (peridotite, andesite, diorite and others; also conglomerate of hard dark-colored rock fragments.

Variations: Soil is generally stony and less than 36 inches thick on hilly to steep land but is many feet thick on level to only gently sloping areas and in depressions. It is generally more granular and friable at the higher elevations. It is redder in the regions of higher rainfall. Many small areas of highly plastic soils. Includes bands of alluvial soils bordering streams.

Topography: Hilly to steep with many high ridges and rock outcrops; only small level to gently sloping areas.

Drainage: Under natural conditions excellent to excessive surface drainage and good internal drainage.

Vegetation[b/]: Forest cover; abandoned cultivated areas overgrown with cogon grass. Very little used for planted crops.

Chemical Properties: Acid reaction. Low to moderate fertility.

Group Symbols[c/]: CL; A-4, A-6. MH, A-5.

Consistence and Structure: Friable and granular under natural conditions.

Cohesion, Permeability, and Volume Changes: Low cohesion. Generally permeable; slight to medium change in volume except in local areas.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires heavy grading and in places rock cutting or blasting.

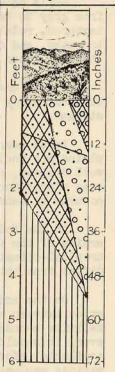
Foundation Properties[d/e/]: Fair to poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller. Requires surface of aggregate for best results.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 6: Clay soils over shale, sandstone, and conglomerate



Surface Soil: Brown to yellowish brown or dusky yellow plastic clay loam, sandy clay, or friable sandy loam. Some stony or gravelly textures where the soil is from sandstone or conglomerate. 10 to 15 inches thick.

Subsoil: Light-brown to yellowish brown gritty, plastic clay loam or stiff sandy clay 15 to 40 inches thick.

Parent Rock: Shale, weathered sandstone, or conglomerate.

Variations: Soil is generally thin on steep slopes. Clayey textures are wide-spread. Sandy textures may be found on steep slopes where the soil is from sandstone. Soil from conglomerate is reddish brown. Includes bands of alluvial soils bordering streams.

Topography: Chiefly rolling to hilly areas with sandstone ridges and escarpments.

Drainage: Excellent surface drainage. Generally excellent to good internal drainage under natural conditions, but practically impervious when compacted while wet.

Vegetation[b/]: Chiefly forest cover. Planted areas are used for abaca (manila hemp).

Chemical Properties: Generally acid surface soil and subsoil. Moderate to low fertility.

Group Symbols[c/]: CH;A-6, A-7. Some SP, A-3.

Consistence and Structure: Friable to plastic. Massive to granular structure.

Cohesion, Permeability, and Volume Changes: Moderate cohesion; permeable to impermeable; subject to moderate or large changes in volume with changes in moisture.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires moderate grading with occasional cutting of bedrock banks.

Foundation Properties[d/e/]: Generally poor but ranges from very poor to fair. Clayey covering generally underlain by soft rocks.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with heavy tamping roller.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 7: Undifferentiated Clayey soils over limestone, sandstone, and conglomerate

See profiles for soils 1 (a), 1 (b), and 6.

Surface Soil: Similar to soils in Map Units 1 and 6.

Subsoil: Similar to soils in Map Units 1 and 6.

Parent Rock: Similar to soils in Map Units 1 and 6.

Variations: Where soil is developed from bentonitic shale, it is very plastic and undergoes wide changes in volume with variations in moisture. Includes bands of alluvial soils bordering streams.

Topography: Sloping to hilly; locally steep.

Drainage: Generally good to excessive surface drainage; excellent internal drainage except where soils contain bentonite. At these locations, internal drainage may be poor.

Vegetation: Broadleaf forest with some cultivated areas and cogon grass.

Chemical Properties: Generally acid.

Group Symbols[c/]: CL;A-4,A-6. CH;A-6, A-7.

Consistence and Structure: Friable to plastic; granular; blocky or massive structure.

Cohesion, Permeability, and Volume Changes: High to low cohesion. Variable permeability; subject to wide changes in volume and permeability especially where soil contains bentonitic material.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Requires clearing and in places rock cutting and blasting.

Grading: Requires moderate grading.

Foundation Properties[d/e/]: Generally poor but ranges from very poor to fair. Unstable where soil materials contain bentonite.

Value as Base Directly Under Wearing Surface[e/]: Good to very poor.

Mechanical Stabilization: Very difficult to stabilize where bentonitic. Requires surface covering of aggregate, also protection from changes in soil moisture. Should be compacted while dry.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 8 Unclassified

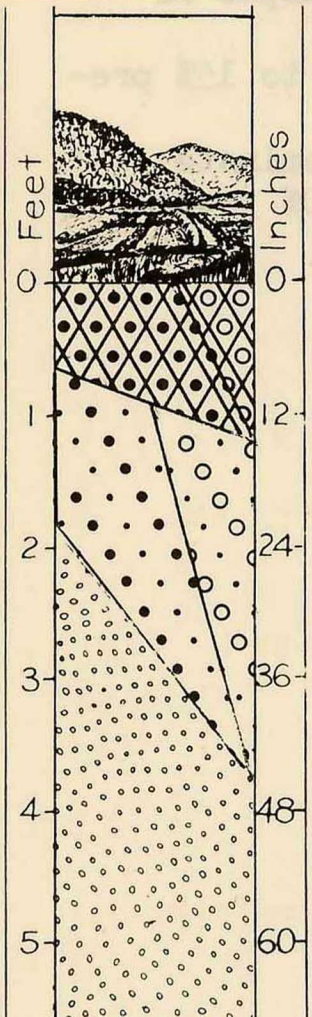
Data on Soil Conditions are unavailable.

a/ In airfield construction this layer may be stripped off and used in places where a cover of grass or other plants is desirable.
b/ For more detialed information see Vegetation Sheet.
c/ Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
d/ Values are for subgrade and base courses except for base courses directly under wearing surface.
e/ Evaluation for guidance only. Design should be based on test results.

Prepared by U. S. Geological Survey in collaboration with Div. of Soil Surv., Bur. Plant Ind., Soils and Agri. Eng. U. S. D. A. for Chief of Engineers, U. S. Army.

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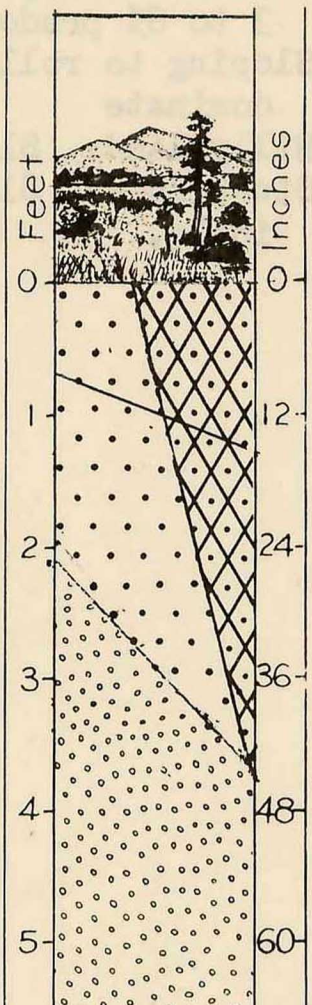
Map Unit 4: Sandy to clayey soils over Alluvium



(a) Silt loams to sandy loams chiefly in lowland belt of northeastern Leyte.

Surface Soil: Light brownish gray to yellowish brown, slightly granular, and moderately friable silt loam to sandy loam, 8 to 15 inches thick

Subsoil: Yellowish brown or dusky yellow plastic silty clay to stiff impervious sandy clay 15 to 30 inches thick; overlies thick stratified deposits of sand,



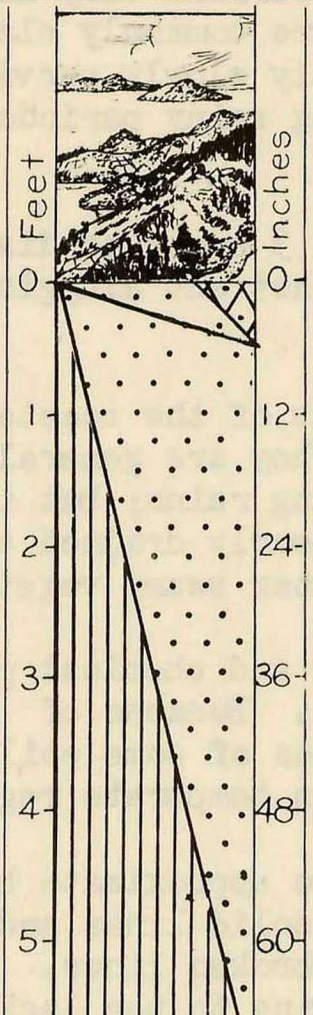
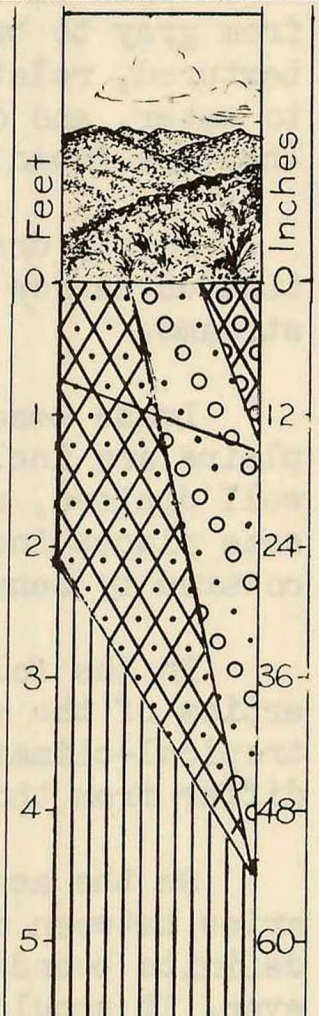
(b) Clay lo
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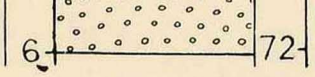
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Reliability: Poor

	Map Unit 5: Clayey Soils chiefly over hard, massive rocks	Map Unit 6: Clay soils o shale, sandstone, and con
ams to cur in d belt stern as nar- border- s.		
il: Brown stiff to clay loam 10 to s thick. Imper- lastic m or clay; wn or ding to ay with 5 to 30 hick; thick	Surface Soil: Reddish-brown, friable, granular clay loam or clay; stony in some places. Generally 4 to 6 inches thick but in places absent. Subsoil: Brown to reddish-brown friable clay. 0 to several feet thick. Parent Rock: Dark hard, massive rocks (peridotite, andesite, diorite and others; also conglomerate of hard dark-colored rock fragments.	Surface So to yello or dusky plastic sandy cl friable loam. S or grave tures wh soil is sandston conglome to 15 in thick. Subsoil: brown to ish brow plastic or stiff clay 15 inches t Parent Roc weathere

SAMAR AND LEYTE(P.I.)

ver glomerate	Map Unit 7: Undifferentiated Clayey soils over limestone, sandstone, and conglomerate		Map Unit 8 Unclassified
il: Brown wish brown yellow clay loam, ay, or sandy ome stony lly tex- ere the from e or rate. 10 ches Light- yellow- n gritty, clay loam sandy to 40 hick. k: Shale, d sand-	See profiles for soils 1 (a), 1 (b), and 6.	<u>Surface Soil</u>: Similar to soils in Map Units 1 and 6. <u>Subsoil</u>: Similar to soils in Map Units 1 and 6. <u>Parent Rock</u>: Similar to soils in Map Units 1 and 6. <u>Variations</u>: Where soil is developed from bentonitic shale, it is very plastic and undergoes wide changes in volume with variations in moisture. Includes bands of alluvial soils bordering streams. <u>Topography</u>: Sloping to hilly; locally	Data on Soil Conditions are unavailable.



silt clay and gravel.

Parent Rock: Mixed alluvium.

Variations: Silty soils occur on the lower portions and sandy soils on the upper portions of alluvial fans and piedmont slopes At some places the soils have impervious, plastic, clayey subsoils (strongly developed clay pans). Includes small narrow bands of sandy well drained alluvial soils bordering streams.

Topography: Chiefly level to undulating land but includes narrow, in places hilly, alluvial fans and piedmont slopes.

Drainage: Generally well drained but may have slow internal drainage in some of the soils that occur on nearly level to gently sloping areas. Practically impervious when compacted.

Vegetation[b]: A large proportion of this map unit is in planted crops. Rice on the level to gently sloping areas and abaca (manila hemp) on the well-drained, sloping uplands are the chief crops.

Chemical Properties: Generally acid in both the surface soil and subsoil. Low to moderate fertility.

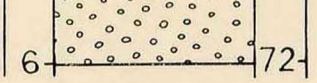
Group Symbol[c]: CH; A-6,A-7 Small amount of SF, A-2.

Consistence and Structure: Friable to plastic. Massive to blocky structure.

Cohesion, Permeability, and Volume Changes: Low to moderate cohesion. Permeable to impermeable; moderate changes in volume with moisture changes.

Bearing Ratio at Optimum Compaction: Fair to poor.

Clearing: Some areas require clear-



stratifi
posits o
sand, si
clay.

Parent Rock: Mixed alluvi
bedrock at various depth

Variations: Narrow bands
well-drained soils; bord
streams are generally we
drained; have good to ex
bearing ratio and founda
properties.

Topography: Chiefly level
cludes some undulating l

Drainage: Generally poor
and internal drainage.
ally impervious when com

Vegetation[b]: Used chiefly
the production of rice.
areas are in sugar cane.
small areas are forested

Chemical Properties: Chie
Varies from acid to limy

Group Symbol[c]: CH,A-7;CL

Consistence and Structure:
erally plastic with mass
blocky structure.

Cohesion, Permeability, an
Changes: High cohesion;
impermeable. Moderate c
in volume.

Bearing Ratio at Optimum C
Very poor to fair.

Clearing: Some areas requir
ing.

Grading: Requires fill a
in low areas.

Foundation Properties[d/e]:
erally poor.

Value as Base Directly Und
ing Surface[e]: Not suita

Mechanical Stabilization:
be stabilized only under
moisture conditions.

Suitability for Stabilizat
Portland Cement or Bitum
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Variations: Soil is generally stony and less than 36 inches thick on hilly to steep land but is many feet thick on level to only gently sloping areas and in depressions. It is generally more granular and friable at the higher elevations. It is redder in the regions of higher rainfall. Many small areas of highly plastic soils. Includes bands of alluvial soils bordering streams.

Topography: Hilly to steep with many high ridges and rock outcrops; only small level to gently sloping areas.

Drainage: Under natural conditions excellent to excessive surface drainage and good internaldrainage.

Vegetation[b/]: Forest cover; abandoned cultivated areas overgrown with cogon grass. Very little used for planted crops.

Chemical Properties: Acid reaction. Low to moderate fertility.

Group Symbol[c/]: CL; A-4, A-6. MH, A-5.

Consistance and Structure: Friable and granular under natural conditions.

Cohesion, Permeability, and Volume Changes: Low cohesion. Generally permeable; slight to medium change in volume except in local areas.

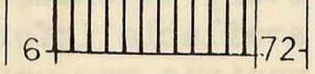
Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires heavy grading and in places rock cutting or blasting.

Foundation Properti es[d/e/]: Fair to poor.

Value as Base Directly Under Wear-



stone, o
glomerat

Variations: Soil is gener
thin on steep slopes. C
textures are wide-spread
textures may be found on
slopes where the soil is
sandstone. Soil from co
erate is reddish brown.
bands of alluvial soils
streams.

Topography: Chiefly rollin
hilly areas with sandsto
and escarpments.

Drainage: Excellent surfa
age. Generally excellen
good internal drainage u
natural conditions, but
tically impervious when
ed while wet.

Vegetation[b/]: Chiefly for
cover. Planted areas ar
for abaca (manila hemp).

Chemical Properties: Gene
acid surface soil and su
Moderate to low fertilit

Group Symbol[c/]: CH;A-6, A
Some SP, A-3.

Consistence and Structure:
able to plastic. Massiv
granular structure.

Cohesion, Permeability, an
Changes: Moderate cohes
permeable to impermeable
ject to moderate or larg
in volume with changes i
ture.

Bearing Ratio at Optimum C
Poor to fair.

Clearing: Requires clearin

Grading: Requires moderat
with occasional cutting
rock banks.

Foundation Properties[d/e/]:
erally poor but ranges f
very poor to fair. Clay
covering generally under
by soft rocks.

steep.

Drainage: Generally good to excessive surface drainage; excellent internal drainage except where soils contain bentonite. At these locations, internal drainage may be poor.

Vegetation: Broadleaf forest with some cultivated areas and cogon grass.

Chemical Properties: Generally acid.

Group Symbols[c]: CL;A-4,A-6. CH;A-6, A-7.

Consistence and Structure: Friable to plastic; granular; blocky or massive structure.

Cohesion, Permeability, and Volume Changes: High to low cohesion. Variable permeability; subject to wide changes in volume and permeability especially where soil contains bentonitic material.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Requires clearing and in places rock cutting and blasting.

Grading: Requires moderate grading.

Foundation Properties[d/e]: Generally poor but ranges from very poor to fair. Unstable where soil materials contain bentonite.

Value as Base Directly Under Wearing Surface[e]: Good to very poor

Mechanical Stabilization: Very difficult to stabilize where bentonitic. Requires surface covering of aggregate, also protection from changes in soil moisture. Should be compacted while dry.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

ing. Grading: Requires moderate grading or fills. Foundation Properties[d/e]: Generally poor to very poor. Value as Base Directly Under Wearing Surface[e]: Not suitable Mechanical Stabilization: Should be stabilized only under optimum moisture conditions. Should be compacted with heavy tamping rollers. Requires surface of aggregate for best results. Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.	

	ing Surface[e]: Not suitable. Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller. Requires surface of aggregate for best results. Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.	Value as Base Directly Und ing Surface[e]: Not suit Mechanical Stabilization: be stabilized under opti moisture conditions with tamping roller. Suitability for Stabilizat Portland Cement or Bitum suitable.

[a] In airfield construction this layer may be stripped off and used in places where a cover of grass or other plants is desirable.
[b] For more detialed information see Vegetation Sheet.
[c] Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
[d] Values are for subgrade and base courses except for base courses directly under wearing surface.
[e] Evaluation for guidance only. Design should be based on test result

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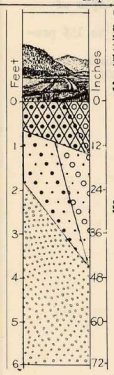
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ared by U. S. Geological Survey in collaboration with
of Soil Surv., Bur. Plant Ind., Soils and Agri. Eng.
. D. A. for Chief of Engineers, U. S. Army.

Reliability: Poor

Map Unit 4: Sandy to clayey soils over Alluvium



(a) Silt loams to sandy loams chiefly in lowland belt of northeastern Leyte.

Surface Soil: Light brownish gray to yellowish brown, slightly granular, and moderately friable silt loam to sandy loam, 8 to 15 inches thick

Subsoil: Yellowish brown or dusky yellow plastic silty clay to stiff impervious sandy clay 15 to 30 inches thick; overlies thick stratified deposits of sand, silt clay and gravel.

Parent Rock: Mixed alluvium.

Variations: Silty soils occur on the lower portions and sandy soils on the upper portions of alluvial fans and piedmont slopes At some places the soils have impervious, plastic, clayey subsoils (strongly developed clay pans). Includes small narrow bands of sandy well drained alluvial soils bordering streams.

Topography: Chiefly level to undulating land but includes narrow, in places hilly, alluvial fans and piedmont slopes.

Drainage: Generally well drained but may have slow internal drainage in some of the soils that occur on nearly level to gently sloping areas. Practically impervious when compacted.

Vegetation[b/]: A large proportion of this map unit is in planted crops. Rice on the level to gently sloping areas and abaca (manila hemp) on the well-drained, sloping uplands are the chief crops.

Chemical Properties: Generally acid in both the surface soil and subsoil. Low to moderate fertility.

Group Symbol[c/]: CH; A-6,A-7 Small amount of SF, A-2.

Consistence and Structure: Friable to plastic. Massive to blocky structure.

Cohesion, Permeability, and Volume Changes: Low to moderate cohesion. Permeable to impermeable; moderate changes in volume with moisture changes.

Bearing Ratio at Optimum Compaction: Fair to poor.

Clearing: Some areas require clearing.

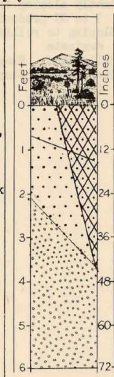
Grading: Requires moderate grading or fills.

Foundation Properties[d/e/]: Generally poor to very poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable

Mechanical Stabilization: Should be stabilized only under optimum moisture conditions. Should be compacted with heavy tamping rollers. Requires surface of aggregate for best results.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.



(b)Clay loams to clays: occur in the lowland belt of northeastern Leyte and as narrow bands bordering streams.

Surface Soil: Brown to plastic clay loam or clay. 10 to 15 inches thick.

Subsoil: Impervious, plastic clay loam or clay; pale brown or gray grading to light gray streaked with brown; 15 to 30 inches thick; overlies thick stratified deposits of gravel, sand, silt, or clay.

Parent Rock: Mixed alluvium; bedrock at various depths.

Variations: Narrow bands of sandy well-drained soils; bordering streams are generally well-drained; have good to excellent bearing ratio and foundation properties.

Topography: Chiefly level but includes some undulating land.

Drainage: Generally poor surface and internal drainage. Practically impervious when compacted.

Vegetation[b/]: Used chiefly for the production of rice. Small areas are in sugar cane. Other small areas are forested.

Chemical Properties: Chiefly acid. Varies from acid to limy.

Group Symbol[c/]: CH,A-7;CL,A-6.

Consistence and Structure: Generally plastic with massive to blocky structure.

Cohesion, Permeability, and Volume Changes: High cohesion; generally impermeable. Moderate changes in volume.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Some areas require clearing.

Grading: Requires fill and piling in low areas.

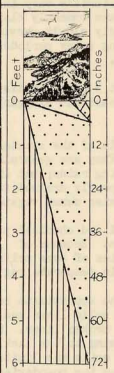
Foundation Properties[d/e/]: Generally poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized only under optimum moisture conditions.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 5: Clayey Soils chiefly over hard, massive rocks



Surface Soil: Reddish-brown, friable, granular clay loam or clay; stony in some places. Generally 4 to 6 inches thick but in places absent.

Subsoil: Brown to reddish-brown friable clay. 0 to several feet thick.

Parent Rock: Dark hard, massive rocks (peridotite, andesite, diorite and others; also conglomerate of hard dark-colored rock fragments.

Variations: Soil is generally stony and less than 36 inches thick on hilly to steep land but is many feet thick on level to only gently sloping areas and in depressions. It is generally more granular and friable at the higher elevations. It is redder in the regions of higher rainfall. Many small areas of highly plastic soils. Includes bands of alluvial soils bordering streams.

Topography: Hilly to steep with many high ridges and rock outcrops; only small level to gently sloping areas.

Drainage: Under natural conditions excellent to excessive surface drainage and good internaldrainage.

Vegetation[b/]: Forest cover; abandoned cultivated areas overgrown with cogon grass. Very little used for planted crops.

Chemical Properties: Acid reaction. Low to moderate fertility.

Group Symbol[c/]: CL; A-4, A-6. MH, A-5.

Consistence and Structure: Friable and granular under natural conditions.

Cohesion, Permeability, and Volume Changes: Low cohesion. Generally permeable; slight to medium change in volume except in local areas.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires heavy grading and in places rock cutting or blasting.

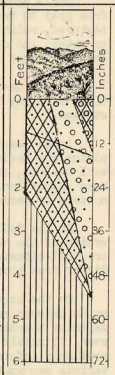
Foundation Properties[d/e/]: Fair to poor.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller. Requires surface of aggregate for best results.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 6: Clay soils over shale, sandstone, and conglomerate



Surface Soil: Brown to yellowish brown or dusky yellow plastic clay loam, sandy clay, or friable sandy loam. Some stony or gravelly textures where the soil is from sandstone or conglomerate. 10 to 15 inches thick.

Subsoil: Light-brown to yellowish brown gritty, plastic clay loam or stiff sandy clay 15 to 40 inches thick.

Parent Rock: Shale, weathered sandstone, or conglomerate.

Variations: Soil is generally thin on steep slopes. Clayey textures are wide-spread. Sandy textures may be found on steep slopes where the soil is from sandstone. Soil from conglomerate is reddish brown. Includes bands of alluvial soils bordering streams.

Topography: Chiefly rolling to hilly areas with sandstone ridges and escarpments.

Drainage: Excellent surface drainage. Generally excellent to good internal drainage under natural conditions, but practically impervious when compacted while wet.

Vegetation[b/]: Chiefly forest cover. Planted areas are used for abaca (manila hemp).

Chemical Properties: Generally acid surface soil and subsoil. Moderate to low fertility.

Group Symbol[c/]: CH;A-6, A-7. Some SP, A-3.

Consistence and Structure: Friable to plastic. Massive to granular structure.

Cohesion, Permeability, and Volume Changes: Moderate cohesion; permeable to impermeable; subject to moderate or large changes in volume with changes in moisture.

Bearing Ratio at Optimum Compaction Poor to fair.

Clearing: Requires clearing.

Grading: Requires moderate grading with occasional cutting of bedrock banks.

Foundation Properties[d/e/]: Generally poor but ranges from very poor to fair. Clayey covering generally underlain by soft rocks.

Value as Base Directly Under Wearing Surface[e/]: Not suitable.

Mechanical Stabilization: Should be stabilized under optimum moisture conditions with heavy tamping roller.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 7: Undifferentiated Clayey soils over limestone, sandstone, and conglomerate

See profiles for soils 1 (a), 1 (b), and 6.

Surface Soil: Similar to soils in Map Units 1 and 6.

Subsoil: Similar to soils in Map Units 1 and 6.

Parent Rock: Similar to soils in Map Units 1 and 6.

Variations: Where soil is developed from bentonitic shale, it is very plastic and undergoes wide changes in volume with variations in moisture. Includes bands of alluvial soils bordering streams.

Topography: Sloping to hilly; locally steep.

Drainage: Generally good to excessive surface drainage; excellent internal drainage except where soils contain bentonite. At these locations, internal drainage may be poor.

Vegetation: Broadleaf forest with some cultivated areas and cogon grass.

Chemical Properties: Generally acid.

Group Symbols[c/]: CL;A-4,A-6. CH;A-6, A-7.

Consistence and Structure: Friable to plastic; granular; blocky or massive structure.

Cohesion, Permeability, and Volume Changes: High to low cohesion. Variable permeability; subject to wide changes in volume and permeability especially where soil contains bentonitic material.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Requires clearing and in places rock cutting and blasting.

Grading: Requires moderate grading.

Foundation Properties[d/e/]: Generally poor but ranges from very poor to fair. Unstable where soil materials contain bentonite.

Value as Base Directly Under Wearing Surface[e/]: Good to very poor

Mechanical Stabilization: Very difficult to stabilize where bentonitic. Requires surface covering of aggregate, also protection from changes in soil moisture. Should be compacted while dry.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

Map Unit 8 Unclassified

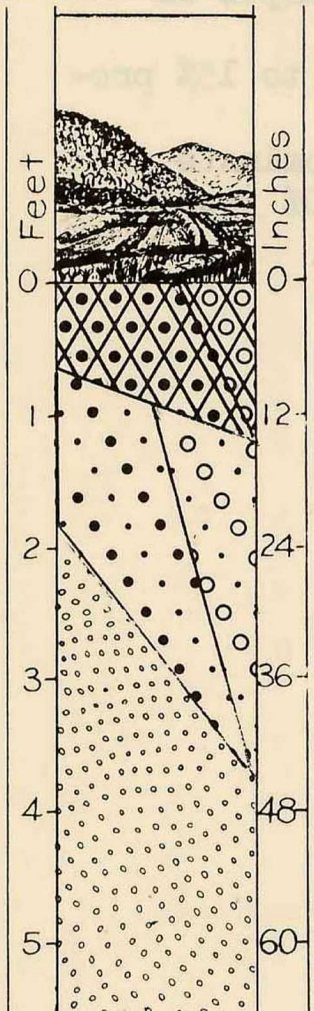
Data on Soil Conditions are unavailable.

a/ In airfield construction this layer may be stripped off and used in places where a cover of grass or other plants is desirable.
b/ For more detialed information see Vegetation Sheet.
c/ Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
d/ Values are for subgrade and base courses except for base courses directly under wearing surface.
e/ Evaluation for guidance only. Design should be based on test results.

Prepared by U. S. Geological Survey in collaboration with Div. of Soil Surv., Bur. Plant Ind., Soils and Agri. Eng. U. S. D. A. for Chief of Engineers, U. S. Army.

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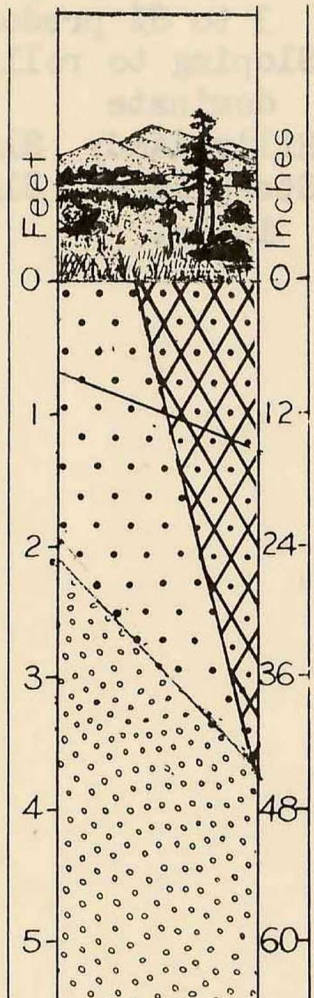
Map Unit 4: Sandy to clayey soils over Alluvium



(a) Silt loams to sandy loams chiefly in lowland belt of northeastern Leyte.

Surface Soil: Light brownish gray to yellowish brown, slightly granular, and moderately friable silt loam to sandy loam, 8 to 15 inches thick

Subsoil: Yellowish brown or dusky yellow plastic silty clay to stiff impervious sandy clay 15 to 30 inches thick; overlies thick stratified deposits of sand,



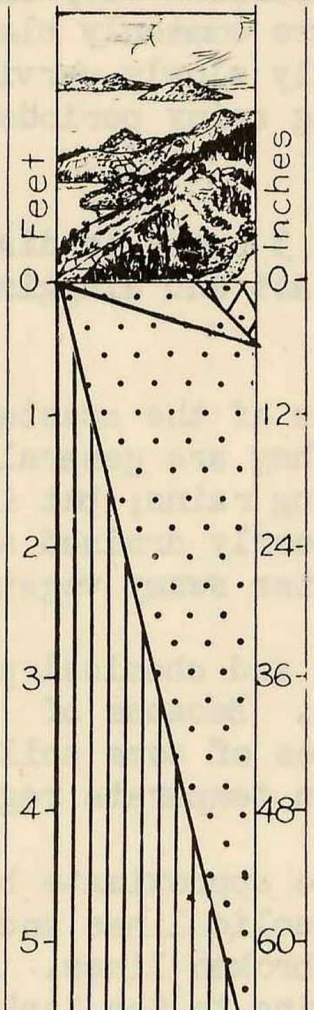
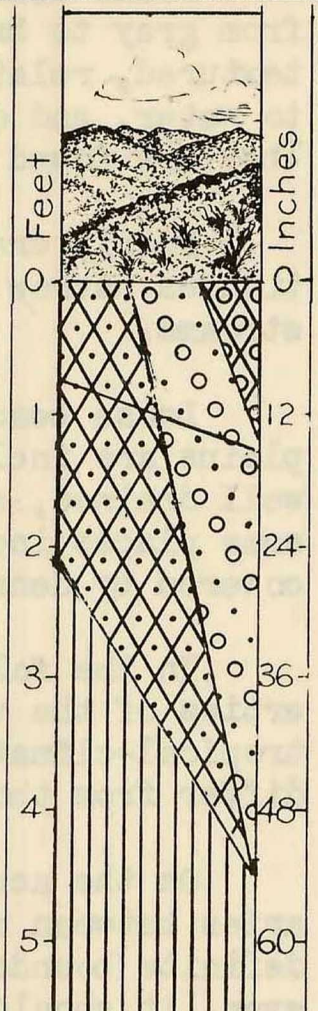
(b) Clay
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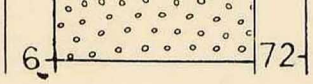
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Reliability: Poor

	Map Unit 5: Clayey Soils chiefly over hard, massive rocks	Map Unit 6: Clay soils shale, sandstone, and c
loams to occur in and belt eastern d as nar- s border- ams.		
Soil: Brown y stiff to c clay loam y. 10 to hes thick. Imper- plastic oam or clay; rown or rading to gray ed with 15 to 30 thick; es thick	Surface Soil: Reddish-brown, friable, granular clay loam or clay; stony in some places. Generally 4 to 6 inches thick but in places absent. Subsoil: Brown to reddish-brown friable clay. 0 to several feet thick. Parent Rock: Dark hard, massive rocks (peridotite, andesite, diorite and others; also conglomerate of hard dark-colored rock fragments.	Surface to yel or dus plasti sandy friabl loam. or gra tures soil i sandst conglo to 15 thick. Subsoil: brown ish br plasti or sti clay l inches Parent R weathe

SAMAR AND LEYTE(P.I.)

over onglomerate	Map Unit 7: Undifferentiated Clayey soils over limestone, sandstone, and conglomerate		Map Unit 8 Unclassified
Soil: Brown lowish brown ky yellow c clay loam, clay, or e sandy Some stony velly tex- where the s from one or merate. 10 inches Light- to yellow- own gritty, c clay loam ff sandy 5 to 40 thick. ock: Shale, red sand-	See profiles for soils 1 (a), 1 (b), and 6.	Surface Soil: Similar to soils in Map Units 1 and 6. Subsoil: Similar to soils in Map Units 1 and 6. Parent Rock: Similar to soils in Map Units 1 and 6. Variations: Where soil is developed from bentonitic shale, it is very plastic and undergoes wide changes in volume with variations in moisture. Includes bands of alluvial soils bordering streams. Topography: Sloping to hilly; locally	Data on Soil Conditions are unavailable.



silt clay and gravel.

Parent Rock: Mixed alluvium.

Variations: Silty soils occur on the lower portions and sandy soils on the upper portions of alluvial fans and piedmont slopes At some places the soils have impervious, plastic, clayey subsoils (strongly developed clay pans). Includes small narrow bands of sandy well drained alluvial soils bordering streams.

Topography: Chiefly level to undulating land but includes narrow, in places hilly, alluvial fans and piedmont slopes.

Drainage: Generally well drained but may have slow internal drainage in some of the soils that occur on nearly level to gently sloping areas. Practically impervious when compacted.

Vegetation[b]: A large proportion of this map unit is in planted crops. Rice on the level to gently sloping areas and abaca (manila hemp) on the well-drained, sloping uplands are the chief crops.

Chemical Properties: Generally acid in both the surface soil and subsoil. Low to moderate fertility.

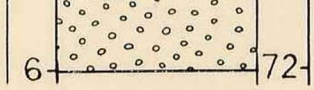
Group Symbol[c]: CH; A-6,A-7 Small amount of SF, A-2.

Consistence and Structure: Friable to plastic. Massive to blocky structure.

Cohesion, Permeability, and Volume Changes: Low to moderate cohesion. Permeable to impermeable; moderate changes in volume with moisture changes.

Bearing Ratio at Optimum Compaction: Fair to poor.

Clearing: Some areas require clear-



strati
posits
sand,

clay.

Parent Rock: Mixed allu
bedrock at various dep

Variations: Narrow band
well-drained soils; bo
streams are generally
drained; have good to
bearing ratio and foun
properties.

Topography: Chiefly lev
cludes some undulating

Drainage: Generally poo
and internal drainage.
ally impervious when c

Vegetation[b]: Used chief
the production of rice
areas are in sugar can
small areas are forest

Chemical Properties: Ch
Varies from acid to li

Group Symbol[c]: CH,A-7;

Consistence and Structur
erally plastic with ma
blocky structure.

Cohesion, Permeability,
Changes: High cohesio
impermeable. Moderate
in volume.

Bearing Ratio at Optimum
Very poor to fair.

Clearing: Some areas requ
ing.

Grading: Requires fill
in low areas.

Foundation Properties[d/e]
erally poor.

Value as Base Directly U
ing Surface[e]: Not sui

Mechanical Stabilization
be stabilized only und
moisture conditions.

Suitability for Stabiliz
Portland Cement or Bit
suitable.

fied de-
of gravel,
silt, or

vium;
ths.
s of sandy
rdering
well-
excellent
dation

el but in-
land.
r surface
Practic-
ompacted.
ly for
. Small
e. Other
ed.
iefly acid.
my.
CL,A-6.
e: Gen-
ssive to

and Volume
n; generally
changes

Compaction:

ire clear-

and piling

/: Gen-

nder Wear-
table.
: Should
er optimum

ation with
umen: Un-

Variations: Soil is generally stony and less than 36 inches thick on hilly to steep land but is many feet thick on level to only gently sloping areas and in depressions. It is generally more granular and friable at the higher elevations. It is redder in the regions of higher rainfall. Many small areas of highly plastic soils. Includes bands of alluvial soils bordering streams.

Topography: Hilly to steep with many high ridges and rock outcrops; only small level to gently sloping areas.

Drainage: Under natural conditions excellent to excessive surface drainage and good internaldrainage.

Vegetation[b/]: Forest cover; abandoned cultivated areas overgrown with cogon grass. Very little used for planted crops.

Chemical Properties: Acid reaction. Low to moderate fertility.

Group Symbol[c/]: CL; A-4, A-6. MH, A-5.

Consistence and Structure: Friable and granular under natural conditions.

Cohesion, Permeability, and Volume Changes: Low cohesion. Generally permeable; slight to medium change in volume except in local areas.

Bearing Ratio at Optimum Compaction: Poor to fair.

Clearing: Requires clearing.

Grading: Requires heavy grading and in places rock cutting or blasting.

Foundation Properti es[d/e/]: Fair to poor.

6 72

stone,
glomer

Variations: Soil is gen
thin on steep slopes.
textures are wide-spre
textures may be found
slopes where the soil
sandstone. Soil from
erate is reddish brown
bands of alluvial soil
streams.

Topography: Chiefly roll
hilly areas with sands
and escarpments.

Drainage: Excellent sur
age. Generally excell
good internal drainage
natural conditions, bu
tically impervious whe
ed while wet.

Vegetation[b/]: Chiefly f
cover. Planted areas
for abaca (manila hemp

Chemical Properties: Ge
acid surface soil and
Moderate to low fertil

Group Symbol[c/]: CH;A-6,
Some SP, A-3.

Consistence and Structur
able to plastic. Mass
granular structure.

Cohesion, Permeability,
Changes: Moderate coh
permeable to impermeab
ject to moderate or la
in volume with changes
ture.

Bearing Ratio at Optimum
Poor to fair.

Clearing: Requires clear

Grading: Requires moder
with occasional cuttin
rock banks.

Foundation Properties[d/e
erally poor but ranges
very poor to fair. Cl
covering generally und
by soft rocks

steep.

Drainage: Generally good to excessive surface drainage; excellent internal drainage except where soils contain bentonite. At these locations, internal drainage may be poor.

Vegetation: Broadleaf forest with some cultivated areas and cogon grass.

Chemical Properties: Generally acid.

Group Symbols[c]: CL;A-4,A-6. CH;A-6, A-7.

Consistence and Structure: Friable to plastic; granular; blocky or massive structure.

Cohesion, Permeability, and Volume Changes: High to low cohesion. Variable permeability; subject to wide changes in volume and permeability especially where soil contains bentonitic material.

Bearing Ratio at Optimum Compaction: Very poor to fair.

Clearing: Requires clearing and in places rock cutting and blasting.

Grading: Requires moderate grading.

Foundation Properties[d/e]: Generally poor but ranges from very poor to fair. Unstable where soil materials contain bentonite.

Value as Base Directly Under Wearing Surface[e]: Good to very poor

Mechanical Stabilization: Very difficult to stabilize where bentonitic. Requires surface covering of aggregate, also protection from changes in soil moisture. Should be compacted while dry.

Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.

ing. Grading: Requires moderate grading or fills. Foundation Properties[d/e]: Generally poor to very poor. Value as Base Directly Under Wearing Surface[e]: Not suitable Mechanical Stabilization: Should be stabilized only under optimum moisture conditions. Should be compacted with heavy tamping rollers. Requires surface of aggregate for best results. Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.	

	Value as Base Directly under Wearing Surface[e]: Not suitable. Mechanical Stabilization: Should be stabilized under optimum moisture conditions with sheepsfoot roller. Requires surface of aggregate for best results. Suitability for Stabilization with Portland Cement or Bitumen: Unsuitable.	Value as Base Directly U ing Surface[e]: Not su Mechanical Stabilization be stabilized under op moisture conditions wi tamping roller. Suitability for Stabiliz Portland Cement or Bit suitable.

[a] In airfield construction this layer may be stripped off and used in places where a cover of grass or other plants is desirable.
[b] For more detialed information see Vegetation Sheet.
[c] Soil symbols follow classification of War Department, Technical Manual 5-255, Aviation Engineers, April 1944.
[d] Values are for subgrade and base courses except for base courses directly under wearing surface.
[e] Evaluation for guidance only. Design should be based on test resu

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nder Wear- itable. : Should timum th heavy ation with umen: Un-		

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epared by U. S. Geological Survey in collaboration with
v. of Soil Surv., Bur. Plant Ind., Soils and Agri. Eng.
S. D. A. for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

SUPPLEMENTARY SOILS DATA - BORING LOGS
Source: ONI intelligence reports

Reliability: Fair

Area No. and Name	ONI Boring No.	Boring Location	Altitude[a]	Topography	Depth of Boring	Soil Description
1. Panirugan Point near Tacloban, Leyte Island	1	900' west of Panirugan Point	10'+	Coastal plain	34"	Red clay
	2	1,700' southwest of Panirugan Point	5'-	" "	34"	Mixed red and black clay
	3	2,000' south of Panirugan Point	5'+	" "	34"	Loose red soil
2. Leyte Island	30	Location not definite (about 10 km south of Tacloban)	Not known	Not known	36"	6" brown clay, 24" light-gray clay, 12" clay and sand
	31	" " " " " " "	20'+	Coastal plain	36"	Dark-brown clay with fine sand
	32	" " " " " " "	10'-	" "	46"	10" brown clay, 36" brown clay and sand
	33	" " " " " " "	10'-	" "	41"	Dark-brown sticky clay
	34	" " " " " " "	10'-	" "	36"	11" dark-brown clay, 25" sticky clay
3. Jinamoc Island	55	200' south of Salvacion (northern end of island)	10'	" "	34"	Mixed sandy clay
	56	1,200' southwest of Salvacion (northern end of island)	10'	" "	34"	Red clay mixed with a little sand
	57	1,200' south of Salvacion (northern end of island)	10'	" "	36"	12" red clay, 24" red clay and sandy loam
	58	1,800' south of Salvacion (northern end of island)	10'	" "	36"	Red clay with little sand
	59	1,800' southwest of Salvacion (northern end of island)	5'	" "	36"	Red clay with very little white sand
	60	2,400' south of Salvacion (northern end of island)	10'	" "	36"	Mixed red and black clay and little sand
4. Parasan Island	90	4,600' northeast of Parasan	342'	Top of small hill	30"	6" loam, 24" sand, gravel, clay, stones
	91	4,400' northeast of Parasan, 1,600' south of boring No. 90	260'	Sloping	48"	12" loam, 36" clay, sand, and gravel
	92	3,600' northeast of Parasan	260'	"	48"	8" loam, 16" clay and gravel, 24" compact clay
	93	2,800' northeast of Parasan	260'	"	32"	Clay loam
	94	1,000' northeast of Parasan	245'	"	48"	6" loam, 18" clay and loam, 12" sandy clay, 12" sand and little gravel
5. Tinaogan Point, Buad Island	95	800 feet north of boring No. 97	80'	On gentle slope	36"	6" dark clay, 30" compact clay and gravel
	96	1,100 feet southeast of boring No. 97	130'	On slope	36"	Compact clay and gravel
	97	Southwest corner of church in southern part of Tinaogan Point	15'	Alluvial plain	54"	6" dark clay, 38" sticky clay, 10" clay and gravel
6. Batairo Bay, Buad Island	98	2,800' northeast of Gamay Island (island in Batairo Bay)	250'	Hilly	36"	Bluish gray clay with volcanic rocks
7. Zumarraga, Buad Island	99	1,200 feet southeast of Zumarraga	10'-	Well-drained level beach	48"	12" loam, 36" clay and sand
	100	Southeast edge of Zumarraga	15'-	Nearly level beach or alluvial plain	48"	24" sand and clay, 24" sand, clay and shell
	101	1,600 feet southwest of Zumarraga	15'	Nearly level coastal plain	48"	8" loam, 12" clay, 28" sand and clay
	102	Shoreline 700 feet southwest of Zumarraga	5'	Beach	48"	4" sand and loam, 44" sand and shell
	103	In Zumarraga	5'	"	48"	24" sand, 24" sand, shell, and gravel
	104	In ocean, 1,400 feet west of Zumarraga (depth of water 12 feet)[b]			11'	6' sounding; 5' sand, rock bottom
	105	In ocean, 1,200 feet west of Zumarraga (depth of water 15 feet)[b]			17'	11' sounding; 6' sand, rock bottom
	106	In ocean, 1,000 feet west of Zumarraga (depth of water 15 feet)[b]			26'	17' sounding; 9' clay and sand, no bottom reached
	107	In ocean, 1,000 feet northwest of Zumarraga			18'	10' sounding; 8' clay and sand, no bottom reached
8. Amantaron Point, Daram Island	108	3,700' northwest of Amantaron Point, 600' west of coast	30'-	Alluvial plain	36'	Dark-brown clay
	109	2,800 feet northwest of Amantaron Point, 400' west of coast	15'	" "	36'	Dark-brown clay

a/ Estimates of altitudes based on topographic maps from Office of Naval Intelligence.

b/ Estimates of depths of water based on maps from Office of Naval Intelligence.

Prepared by U. S. Geological Survey in collaboration with Div. of Soil Surv., Bur. Plant Ind., Soils and Agr. Eng. U. S. D. A. for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

Area No. and Name	ONI Boring No.	
1. Panirugan Point near Tacloban, Leyte Island	1	
	2	1,7
	3	2
2. Leyte Island	30	Locatio
	31	"
	32	"
	33	"
	34	"

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SUPPLEMENTARY SOILS DATA - BORING LOGS
Source: ONI intelligence reports

Reliability: Fair

Boring Location	Altitude[a/]	Topography
900' west of Panirugan Point	10'+	Coastal plain
00' southwest of Panirugan Point	5'-	" "
,000' south of Panirugan Point	5'+	" "
n not definite (about 10 km south of Tacloban)	Not known	Not known
" " " " " "	20'+	Coastal plain
" " " " " "	10'-	" "
" " " " " "	10'-	" "
" " " " " "	10'-	" "

SOILS

Depth of Boring	Soil Description
34"	Red clay
34"	Mixed red and black clay
34"	Loose red soil
36"	6" brown clay, 24" light-gray clay, 12" clay and sand
36"	Dark-brown clay with fine sand
46"	10" brown clay, 36" brown clay and sand
41"	Dark-brown sticky clay
36"	11" dark-brown clay, 25" sticky clay

3. Jinamoc Island	55	200' sout
	56	
	57	
	58	
	59	
	60	
4. Parasan Island	90	
	91	
	92	
	93	
	94	
5. Tinaogan Point, Buad Island	95	8
	96	1,10
	97	Southw
6. Batairo Bay, Buad Island	98	2,8
7. Zumarraga, Buad Island	99	1,2
	100	
	101	1,6

h of Salvacion (northern end of island)	10'	" "
1,200' southwest of Salvacion (northern end of island)	10'	" "
1,200' south of Salvacion (northern end of island)	10'	" "
1,800' south of Salvacion (northern end of island)	10'	" "
1,800' southwest of Salvacion (northern end of island)	5'	" "
2,400' south of Salvacion (northern end of island)	10'	" "
4,600' northeast of Parasan	342'	Top of small hill
4,400' northeast of Parasan, 1,600' south of boring No. 90	260'	Sloping
3,600' northeast of Parasan	260'	"
2,800' northeast of Parasan	260'	"
1,000' northeast of Parasan	245'	"
00 feet north of boring No. 97	80'	On gentle slope
0 feet southeast of boring No. 97	130'	On slope
west corner of church in southern part of Tinaogan Point	15'	Alluvial plain
800' northeast of Gamay Island (island in Batairo Bay)	250'	Hilly
200 feet southeast of Zumarraga	10'-	Well-drained level beach
Southeast edge of Zumarraga	15'-	Nearly level beach or alluvial plain
600 feet southwest of Zumarraga	15'	Nearly level coastal plain

34"	Mixed sandy clay
34"	Red clay mixed with a little sand
36"	12" red clay, 24" red clay and sandy loam
36"	Red clay with little sand
36"	Red clay with very little white sand
36"	Mixed red and black clay and little sand
30"	6" loam, 24" sand, gravel, clay, stones
48"	12" loam, 36" clay, sand, and gravel
48"	8" loam, 16" clay and gravel, 24" compact clay
32"	Clay loam
48"	6" loam, 18" clay and loam, 12" sandy clay, 12" sand and little gravel
36"	6" dark clay, 30" compact clay and gravel
36"	Compact clay and gravel
54"	6" dark clay, 38" sticky clay, 10" clay and gravel
36"	Bluish gray clay with volcanic rocks
48"	12" loam, 36" clay and sand
48"	24" sand and clay, 24" sand, clay and shell
48"	8" loam, 12" clay, 28" sand and clay

	102	Shorel
	103	
	104	In oce
	105	In oce
	106	In oce
	107	In ocea
8. Amantaron Point, Daram Island	108	3,700
	109	2,800

a/

b/

ine 700 feet southwest of Zumarraga	5'	Beach
In Zumarraga	5'	"
ean, 1,400 feet west of Zumarraga (depth of water 12 feet)b/		
ean, 1,200 feet west of Zumarraga (depth of water 15 feet)b/		
ean, 1,000 feet west of Zumarraga (depth of water 15 feet)b/		
n, 1,000 feet northwest of Zumarraga		
0' northwest of Amantaron Point, 600' west of coast	30'-	Alluvial plain
0 feet northwest of Amantaron Point, 400' west of coast	15'	" "

Estimates of altitudes based on topographic maps from Office of Naval Int

Estimates of depths of water based on maps from Office of Naval Intellige

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48"	4" sand and loam, 44" sand and shell
48"	24" sand, 24" sand, shell, and gravel
11'	6' sounding; 5' sand, rock bottom
17'	11' sounding; 6' sand, rock bottom
26'	17' sounding; 9' clay and sand, no bottom reached
18'	10' sounding; 8' clay and sand, no bottom reached
36'	Dark-brown clay
36'	Dark-brown clay

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pared by U. S. Geological Survey in collaboration with
. of Soil Surv., Bur. Plant Ind., Soils and Agr. Eng.
U. S. D. A. for Chief of Engineers, U. S. Army.

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PHILIPPINE ISLANDS 1:500,000

CONSTRUCTION MATERIALS

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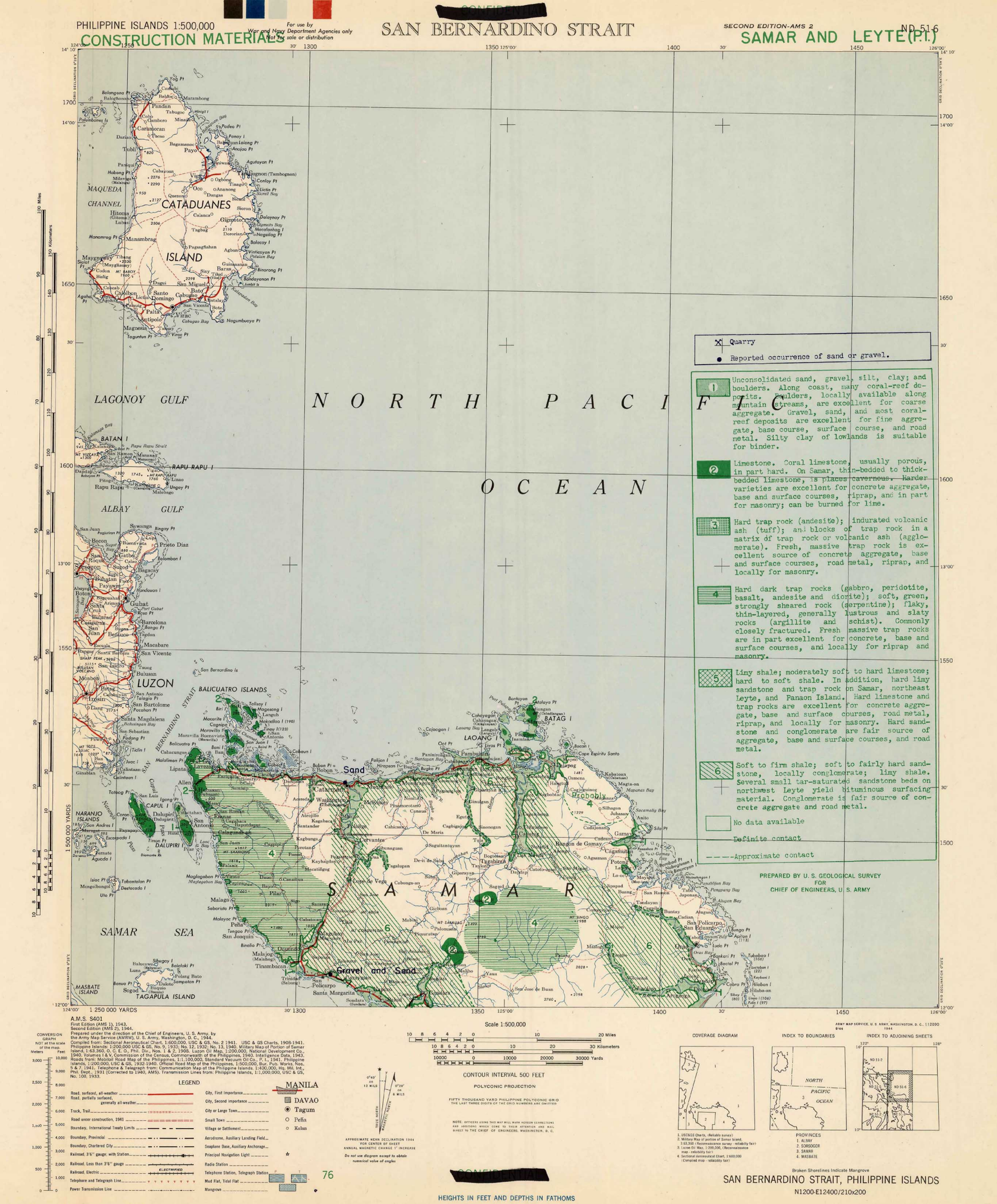
SAN BERNARDINO STRAIT

SECOND EDITION-AMS 2

SAMAR AND LEYTE(P.I.)

ND 51-6

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1 500 000 YARDS

1 250 000 YARDS

A.M.S. S401
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.
Compiled from: Sectional Aeronautical Chart, 1:500,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1932; No. 13, 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1903. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobilol Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Hq. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

CONVERSION GRAPH NOT at the scale of the map.

LEGEND

Road, surfaced, all-weather
Road, partially surfaced, generally all-weather
Track, Trail
Road under construction, 1941
Boundary, International Treaty Limits
Boundary, Provincial
Boundary, Chartered City
Railroad, 3'6" gauge; with Station
Railroad, Less than 3'6" gauge
Railroad, Electric (ELECTRIFIED)
Telephone and Telegraph Line
Power Transmission Line
City, First Importance — MANILA
City, Second Importance — DAVAO
City or Large Town — Tagum
Small Town — Peña
Village or Settlement — Kalan
Aerodrome, Auxiliary Landing Field
Seaplane Base, Auxiliary Anchorage
Principal Navigation Light
Radio Station
Telephone Station, Telegraph Station
Mud Flat, Tidal Flat
Mangrove

Scale 1:500,000

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1° INCREASE
Do not use diagram except to obtain numerical value of angles

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1120?0
1944
S-145

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliability fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:500,000 (Compiled map - reliability fair)

PROVINCES
1. ALBAY
2. SORSOGON
3. SAMAR
4. MASBATE

Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

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PHILIPPINE ISLANDS 1:500,000

CONSTRUCTION MATERIALS

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SAN BERNARDINO STRAIT

1350 125°00′

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)

1400 30′ 1450 126°00′

14° 10′

GRID DECLINATION 0°58′E

1700

14°00′

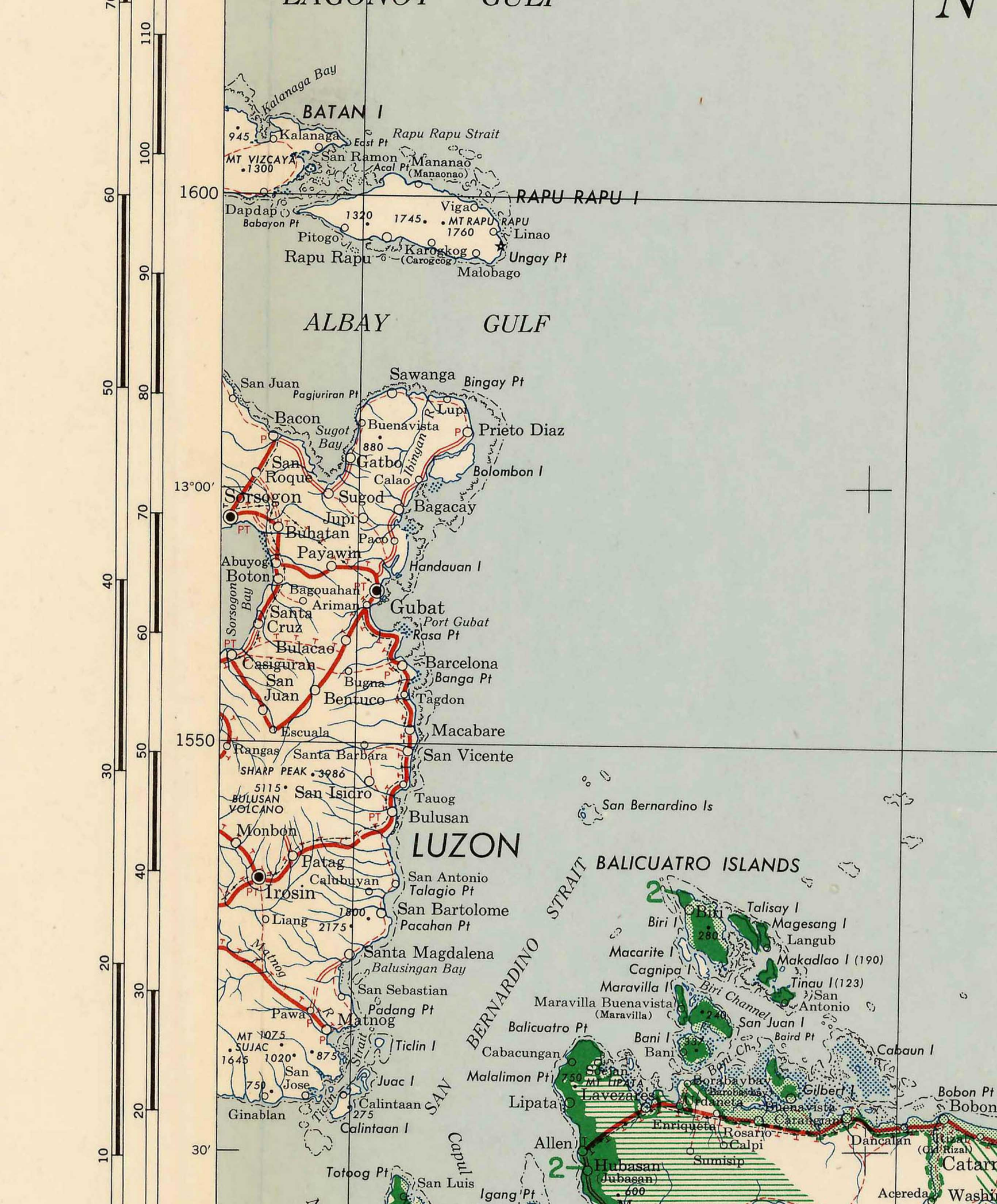
1650

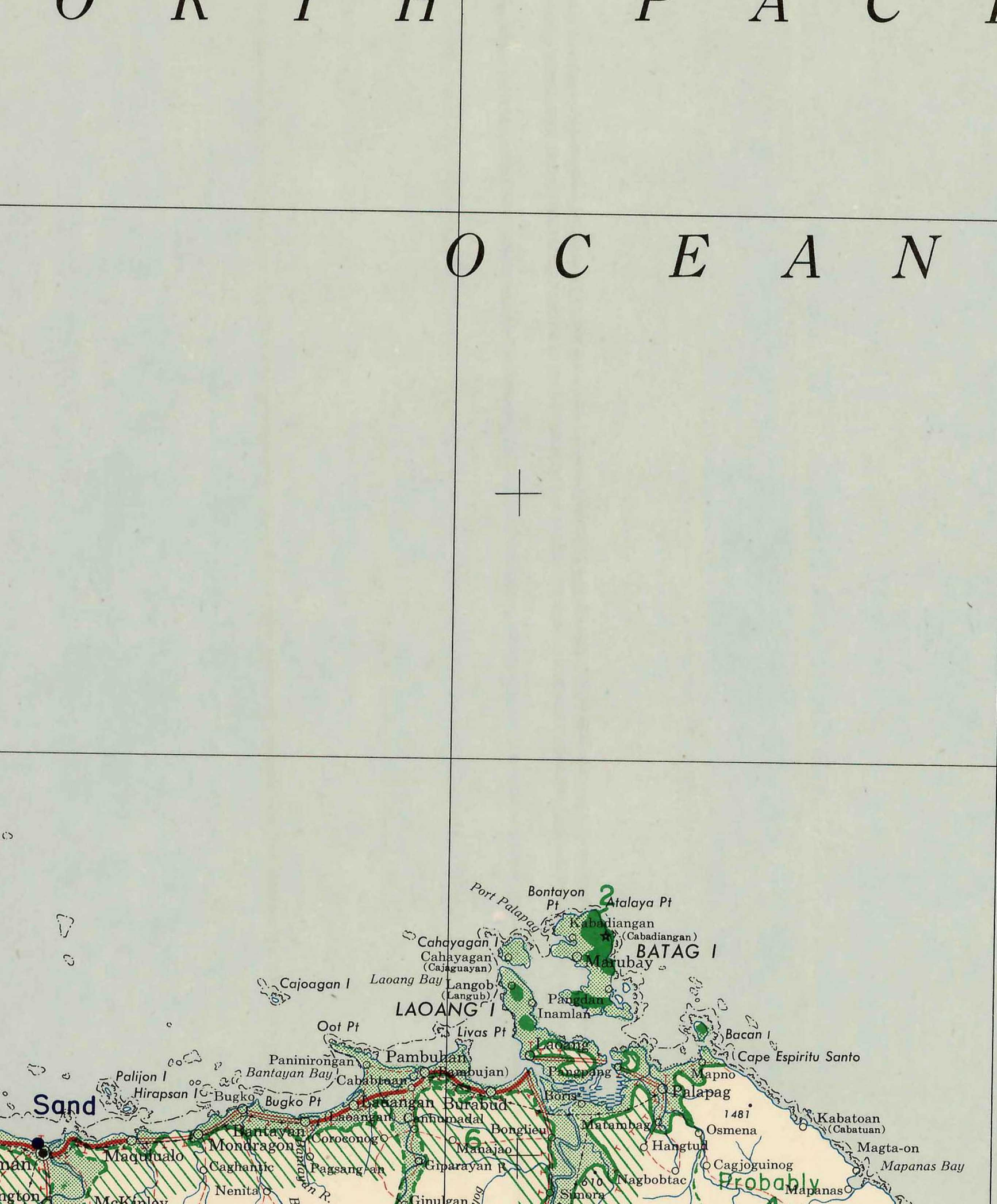
30′

X Quarry

● Reported occurrence of sand or gravel.

1 Unconsolidated sand, gravel, silt, clay; and boulders. Along coast, many coral-reef deposits. Boulders, locally available along


ALBAY GULF
LUZON
BATAN I
RAPU RAPU I
Kalanaga Bay
Kalanaga
East Pt
Rapu Rapu Strait
MT VIZCAYA
1300
San Ramon
Acal Pt
Mananao
(Manaonao)
Dapdap
Babayon Pt
Viga
1320
1745
MT RAPU RAPU
1760
Linao
Pitogo
Karogkog
(Carogcog)
Ungay Pt
Rapu Rapu
Malobago
San Juan
Pagjuriran Pt
Sawanga
Bingay Pt
Lupi
Bacon
Sugot Bay
Buenavista
880
Prieto Diaz
Ibingan R
San Roque
Gatbo
Calao
Bolombon I
Sorsogon
Sugod
Bagacay
Jupi
Buhatan
Paco
Payawin
Handauan I
Abuyog
Boton
Sorsogon Bay
Bagouahan
Ariman
Gubat
Port Gubat
Rasa Pt
Santa Cruz
Bulacao
Casiguran
San Juan
Bugna
Bentuco
Barcelona
Banga Pt
Tagdon
Escuala
Macabare
Rangas
Santa Barbara
San Vicente
SHARP PEAK 3986
5115
BULUSAN VOLCANO
San Isidro
Tauog
Bulusan
San Bernardino Is
Monbon
Patag
Irosin
Calubuyan
San Antonio
Talagio Pt
San Bartolome
Pacahan Pt
1800
2175
Liang
Matnog
Santa Magdalena
Balusingan Bay
San Sebastian
Padang Pt
Pawa
Matnog
MT SUJAC
1645
1020
1075
875
Ticlin I
Strait
San Jose
750
Juac I
Calintaan
275
Calintaan I
Ginablan
Ticlin
SAN BERNARDINO STRAIT
BALICUATRO ISLANDS
Biri
Talisay I
Biri I
280
Magesang I
Langub
Macarite I
Makadlao I (190)
Cagnipa I
Tinau I (123)
Maravilla I
Biri Channel
San Antonio
Maravilla Buenavista
(Maravilla)
240
San Juan I
Balicuatro Pt
Bani I
Bani
Baird Pt
Cabaun I
Cabacungan
Malalimon Pt
750
MT LIPATA
Borabaybay
Gilbert I
Lipata
Lavezares
Bobon Pt
Bobon
Enriqueta
Rosario
Calpi
Dancalan
Allen
Hubasan
(Jubasan)
600
Sumisip
Totoog Pt
San Luis
Igang Pt
Capul
1600
1550
13°00'
30'


OCEAN
Port Palapag
Bontayon Pt
Atalaya Pt
Kabadiangan
(Cabadiangan)
Cahayagan I
Cahayagan
(Cajaguayan)
BATAG I
Marubay
Cajoagan I
Laoang Bay
Langob
(Langub)
LAOANG I
Pangdan
Inamlan
Oot Pt
Livas Pt
Laoang
Bacan I
Cape Espiritu Santo
Paninirongan
Pambuhan
(Pambujan)
Palijon I
Bantayan Bay
Cababtoan
Pangpang
Mapno
Hirapsan I
Bugko
Bugko Pt
Boris
Palapag
Sand
Laoangan
Burabud
Cambumadal
1481
Kabatoan
(Cabatuan)
Bantayan
Coroconog
Bonglieu
Matambag
Osmena
Mondragon
Manajao
Hangtud
Magta-on
Maquiualo
Caghantic
Pagsang-an
Giparayan R
Cagjoguinog
Mapanas Bay
Nenita
Nagbobtac
Probably
Mapanas
Ginulgan
Simora

mountain streams, are excellent for coarse aggregate. Gravel, sand, and most coral-reef deposits are excellent for fine aggregate, base course, surface course, and road metal. Silty clay of lowlands is suitable for binder.

2 Limestone. Coral limestone, usually porous, in part hard. On Samar, thin-bedded to thick-bedded limestone, is places cavernous. Harder varieties are excellent for concrete aggregate, base and surface courses, riprap, and in part for masonry; can be burned for lime.

1600

3 Hard trap rock (andesite); indurated volcanic ash (tuff); and blocks of trap rock in a matrix of trap rock or volcanic ash (agglomerate). Fresh, massive trap rock is excellent source of concrete aggregate, base and surface courses, road metal, riprap, and locally for masonry.

13°00′

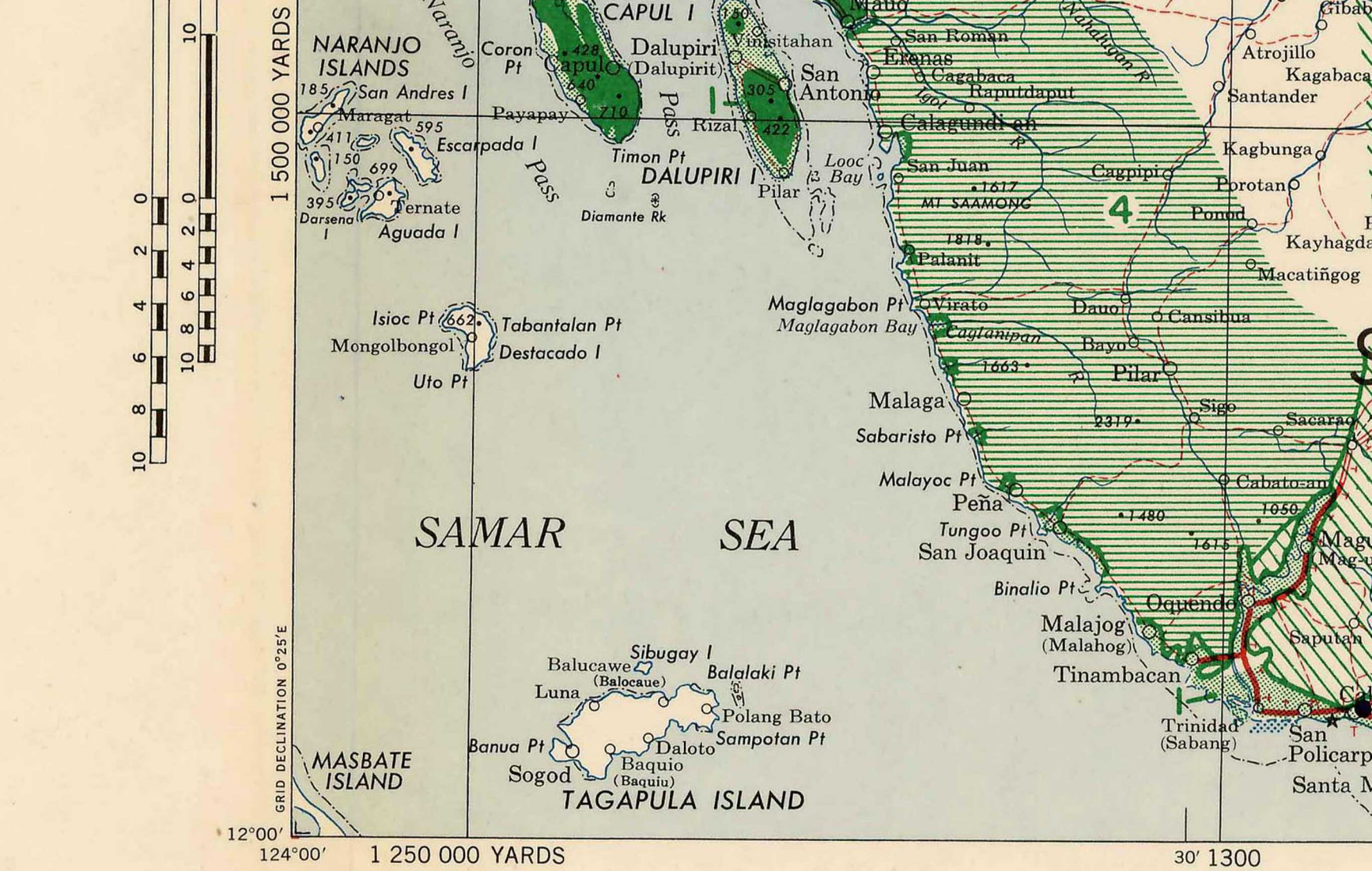
4 Hard dark trap rocks (gabbro, peridotite, basalt, andesite and diorite); soft, green, strongly sheared rock (serpentine); flaky, thin-layered, generally lustrous and slaty rocks (argillite and schist). Commonly closely fractured. Fresh massive trap rocks are in part excellent for concrete, base and surface courses, and locally for riprap and masonry.

1550

5 Limy shale; moderately soft to hard limestone; hard to soft shale. In addition, hard limy sandstone and trap rock on Samar, northeast Leyte, and Panaon Island. Hard limestone and trap rocks are excellent for concrete aggregate, base and surface courses, road metal, riprap, and locally for masonry. Hard sandstone and conglomerate are fair source of aggregate, base and surface courses, and road metal.

6 Soft to firm shale; soft to fairly hard sandstone, locally conglomerate; limy shale. Several small tar-saturated sandstone beds on northwest Leyte yield bituminous surfacing material. Conglomerate is fair source of con-

30′



A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.

Compiled from: Sectional Aeronautical Chart, 1:600,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1932; No. 13, 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1908. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Hq. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

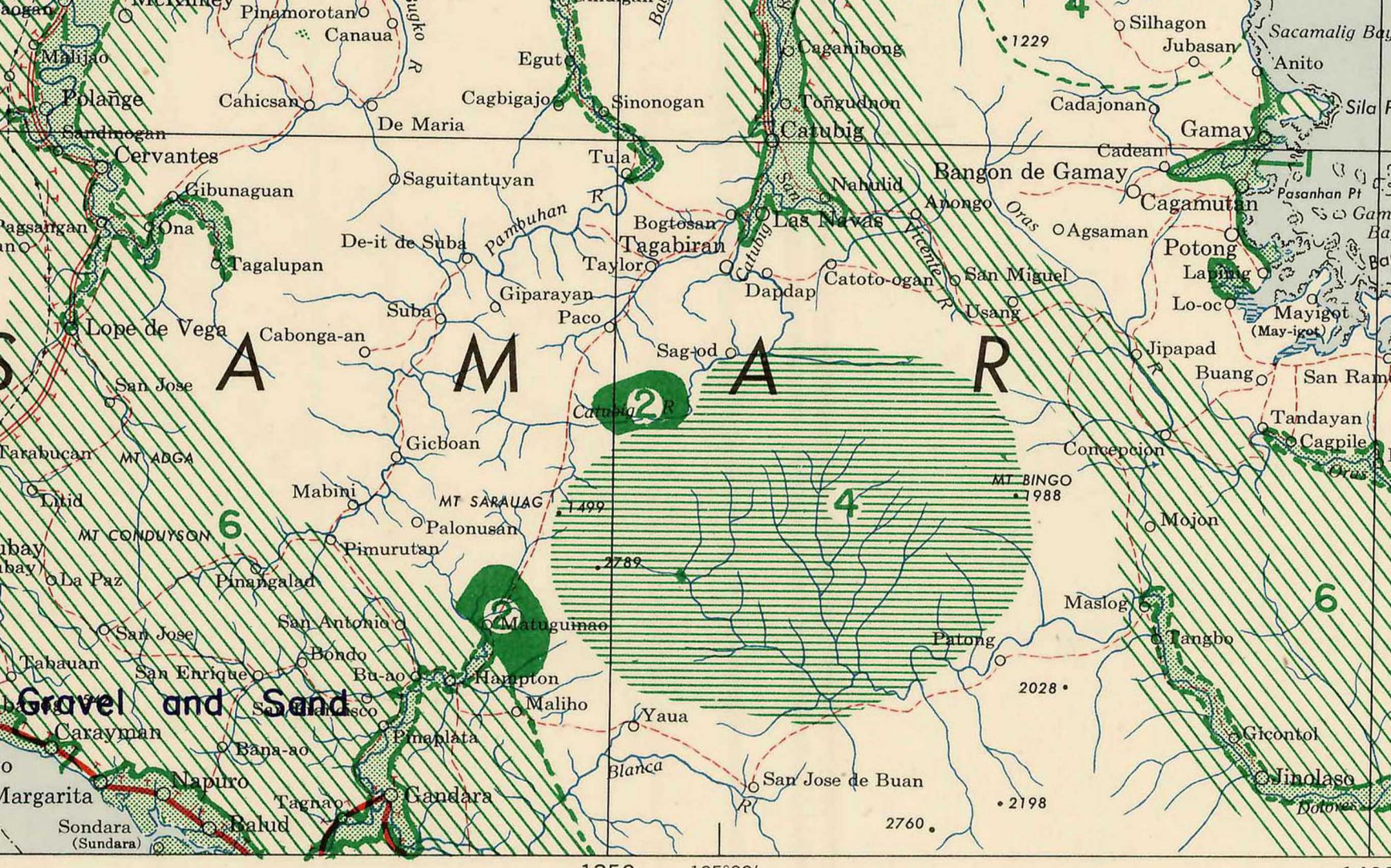
CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
	2,000
500	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric (ELECTRIFIED)
- Telephone and Telegraph Line
- Power Transmission Line

- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station (P, T)
- Mud Flat, Tidal Flat
- Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

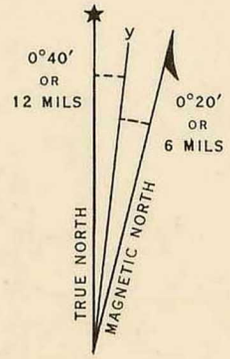
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.



APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1′ INCREASE

Do not use diagram except to obtain numerical value of angles

[redacted]

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

crete aggregate and road metal.

No data available

Definite contact

-----Approximate contact

1500

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

Nabugtusan I
Binarayan I
Hivinatungan I
Panablijon Bay
Tabo
Pangpang Bay
Japonan
Alugan Bay
Buntay
Alugan
Cadian
San Policarpo
San Eduardo
Bunga Pt
Yabo
Lipusan Bay
Apiton I
(113)
Oras
Ludo Pt
Oras Bay
Bankari Pt
Tubabao I
(106)
Dao
Bactol Pt
Luctaban I
(22)
Factoria
Kaybani I
Lojang
Dapdap
Cabra Pt
Hilaban I
Dolores
Hilaba-an
Aroganga
Sibay I
(80)
Linao I (106)
Fulin I (97)

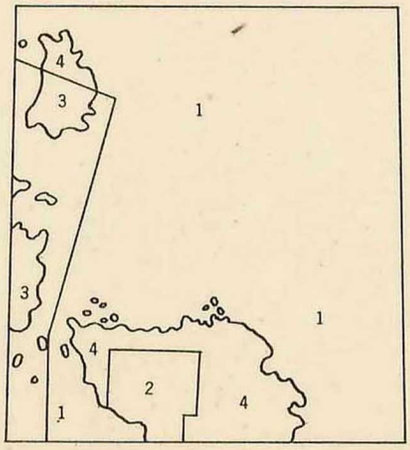
GRID DECLINATION 0°50'E

12°00'

0 30' 1450 126°00'

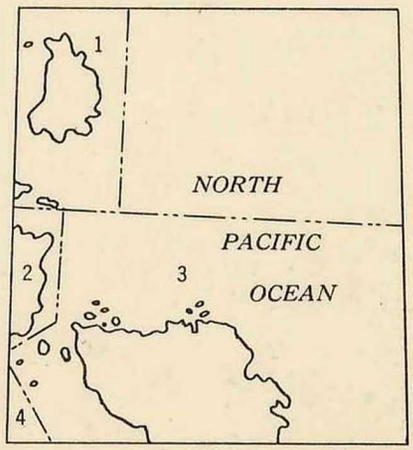
ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090
9-44 1944

COVERAGE DIAGRAM



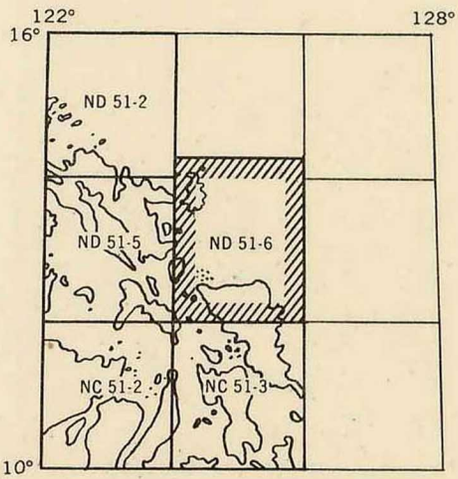
1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliabilty fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

INDEX TO BOUNDARIES



PROVINCES
1. ALBAY
2. SORSOGOR
3. SAMAR
4. MASBATE

INDEX TO ADJOINING SHEETS



Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

[redacted]

PHILIPPINE ISLANDS 1:500,000

CONSTRUCTION MATERIALS

For use by War and Navy Department Agencies only Not for sale or distribution

LEYTE ISLAND

SECOND EDITION-AMS 2

NC 51-3

SAMAR AND LEYTE(PI)

RELIABILITY: Northwest Leyte and Camotes Islands good; remainder of area, poor.



PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

Scale 1:500,000

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEYDON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1 12096 9-44

1. USC&GS Charts. (Reliable survey)
2. Sectional Aeronautical Charts, 1:500,000 (Compiled map - reliability fair.)
3. Philippine Is. USC&GS. (Compiled map - reliability fair.)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944. Compiled from Sec. Aero. Chart, 1:500,000, USC & GS Nos. 2, 3, 1941; USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 1936; 4422, 1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., No. 1, 1908. Standard Recon. Map, Surigao & Augusan, 1:100,000, Inc. Co., No. 1. Vols. I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road Map of the P. I., 1:1,000,000; Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Hq. Mil. Int., Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

CONVERSION GRAPH NOT at the scale of the map. Meters / Feet

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric (ELECTRIFIED)
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance
- City, Second Importance
- City or Large Town
- Small Town
- Village or Settlement
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove

MANILA
DAVAO
Tagum
Peña
Kalan

1 250 000 YARDS

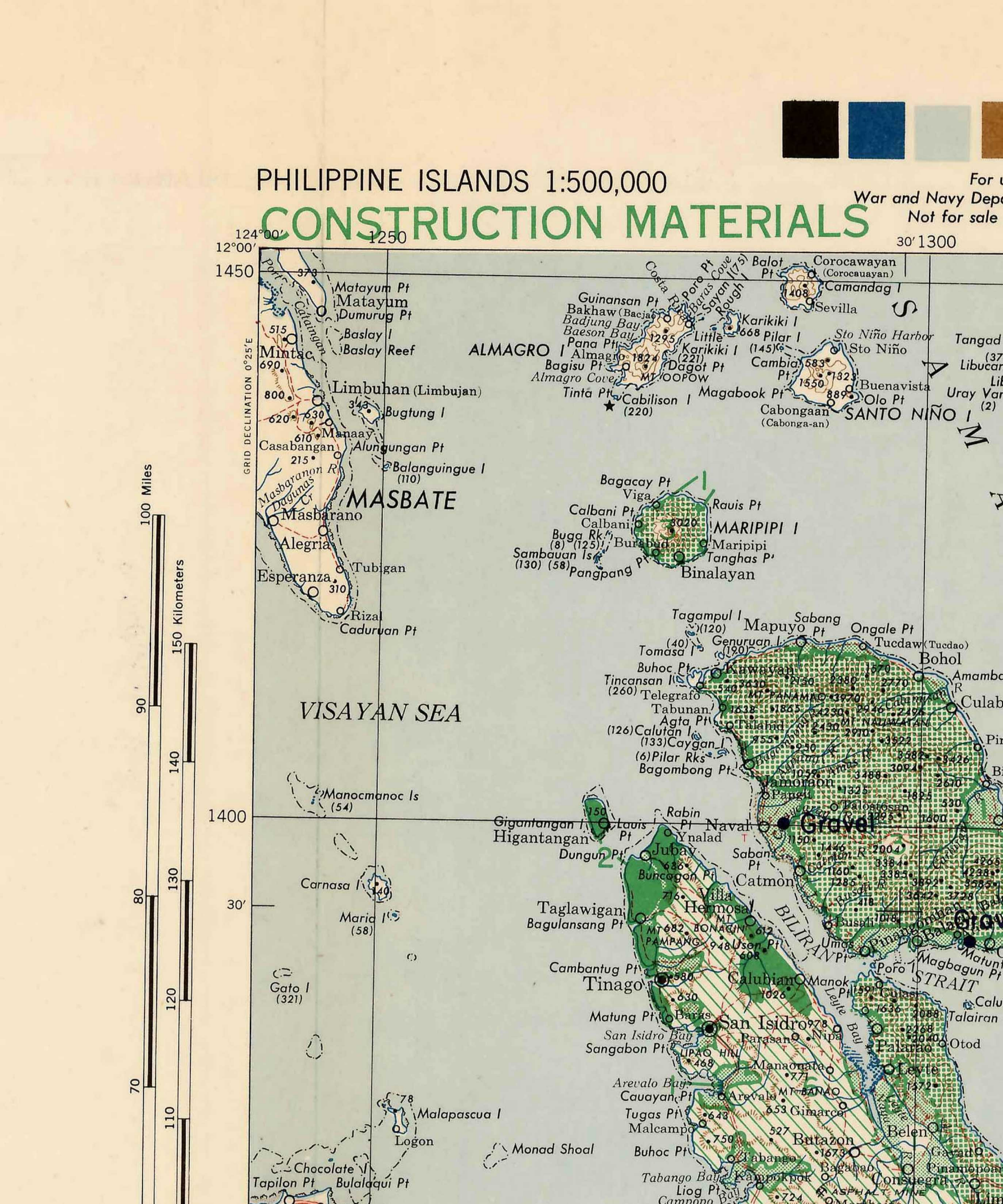
[redacted]

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

PHILIPPINE ISLANDS 1:500,000

CONSTRUCTION MATERIALS

For u
War and Navy Depa
Not for sale



[redacted]

CONFIDENTIAL

use by
artment Agencies only
or distribution

LEYTE ISLAND


1350
125°00'
Hard Limestone Gravel
Gravel
Gravel

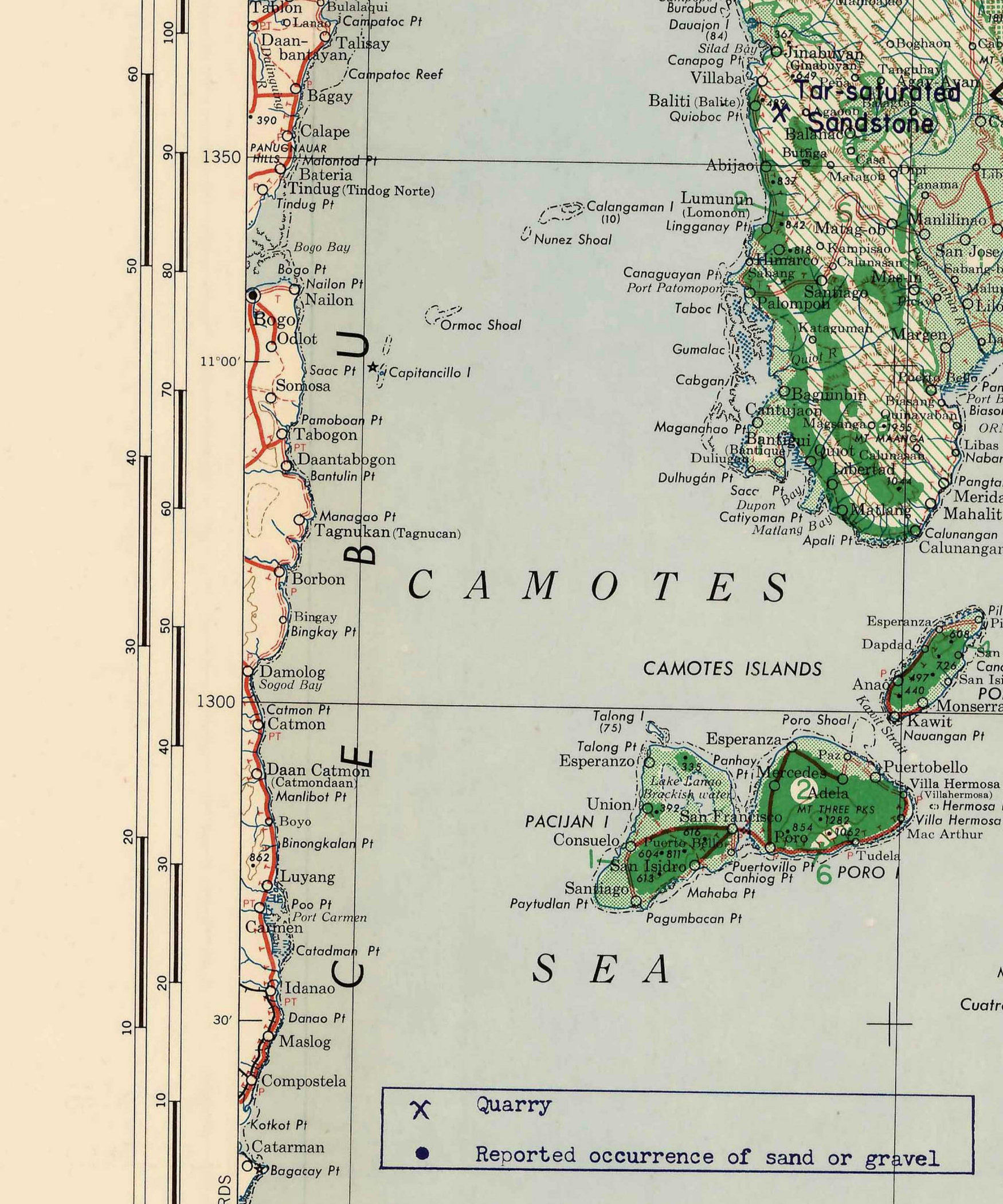
SECOND EDITION-AMS 2

NC 51-3

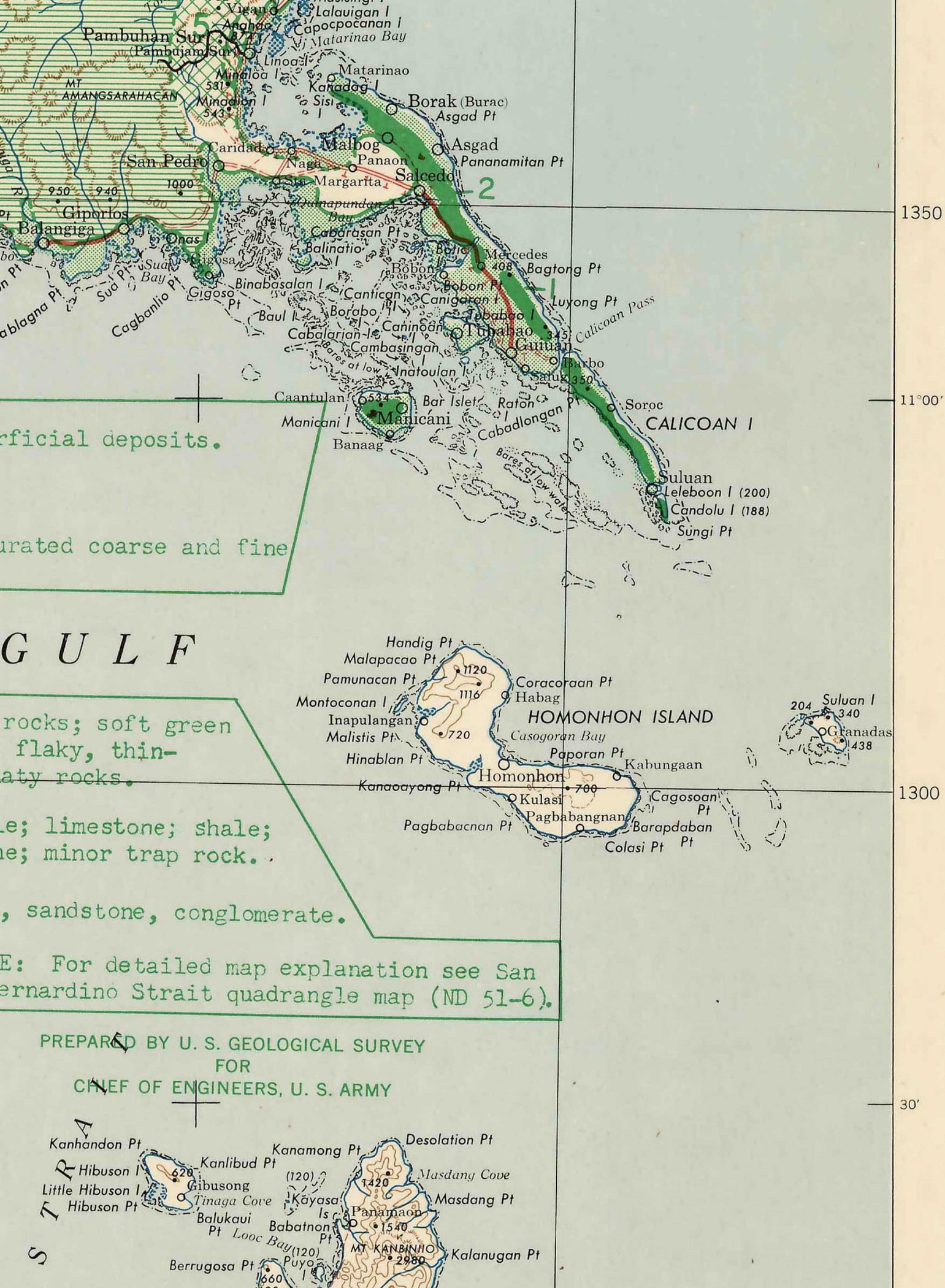
SAMAR AND LEYTE(P.I.)

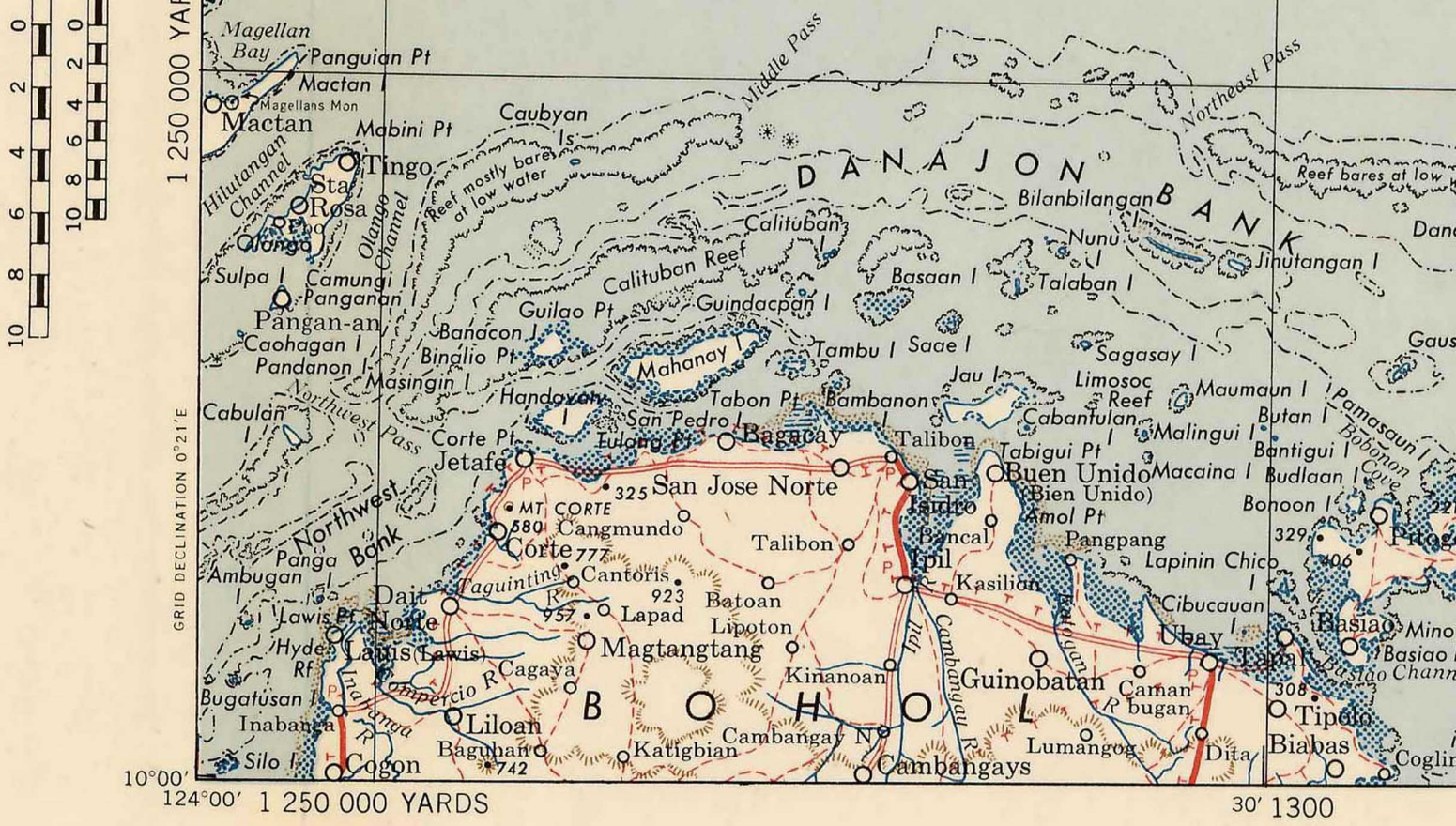
RELIABILTIY: Northwest Leyte and Camotes Islands Good; remainder of area, Poor.




Tar-saturated Sandstone
CAMOTES
CAMOTES ISLANDS
SEA
CEBU
PACIJAN I
Quarry
Reported occurrence of sand or gravel
Tabon
Bulalaqui
Lanao
Campatoc Pt
Daan-bantayan
Talisay
Campatoc Reef
Bagay
Calape
PANUGNAUAR HILLS
Malontod Pt
Bateria
Tindug (Tindog Norte)
Tindug Pt
Bogo Bay
Bogo Pt
Nailon Pt
Nailon
Bogo
Odlot
Saac Pt
Capitancillo I
Somosa
Pamoboan Pt
Tabogon
Daantabogon
Bantulin Pt
Managao Pt
Tagnukan (Tagnucan)
Borbon
Bingay
Bingkay Pt
Damolog
Sogod Bay
Catmon Pt
Catmon
Daan Catmon (Catmondaan)
Manlibot Pt
Boyo
Binongkalan Pt
Luyang
Poo Pt
Port Carmen
Carmen
Catadman Pt
Idanao
Danao Pt
Maslog
Compostela
Kotkot Pt
Catarman
Bagacay Pt
Ormoc Shoal
Calangaman I (10)
Nunez Shoal
Burabud
Dauajon I (84)
Silad Bay
Canapog Pt
Villaba
Baliti (Balite)
Quioboc Pt
Jinabuyan (Ginabuyan)
Boghaon
Tanguhay
Agay-Ayan
Agaodon
Balamaco
Butiga
Casa
Abijao
Matagob
Dipi
Panama
Lumunun (Lomonon)
Lingganay Pt
Matag-ob
Manlilinao
Kampisao
Calunasan
Limarco
Sabang
Canaguayan Pt
Port Patomopon
Santiago
Palompon
Taboc I
Mag-in
San Jose
Sabang-b
Malu
Lilo
Katagumán
Margen
Gumalac
Quiot R
Cabgan I
Puerto Bello
Baguinbin
Biasang
Cantujaon
Quinayaban
Magsanga
Maganhao Pt
Bantigui (Bantique)
Quiot
Calunasan
Libertad
Duliugan
Dulhugán Pt
Sacc Pt
Dupon Bay
Catiyoman Pt
Matlang
Matlang Bay
Apali Pt
Mahalit
Calunangan
Merida
Libas
Nabar
Pangta
Esperanza
Dapdad
Anao
Monserrat
Kawit
Nauangan Pt
Kawit Strait
Poro Shoal
Talong I (75)
Talong Pt
Esperanzo
Panhay Pt
Paz
Mercedes
Puertobello
Villa Hermosa (Villahermosa)
Hermosa
Villa Hermosa
Mac Arthur
Lake Lanao
Brackish water
Union
Adela
MT THREE PKS
San Francisco
Poro
Tudela
Consuelo
Puerto Bello
San Isidro
Puertovillo Pt
Canhiog Pt
PORO I
Santiago
Mahaba Pt
Paytudlan Pt
Pagumbacan Pt
1350
1300
11°00′
30′


Sand
Limestone
Gravel and Sand
Sand
Sand
Sheared slaty rock
Sheared soft green rock
Gravel and Sand
Gravel and Sand
Gravel and Sand
Gravel and Sand
Gravel
1 Unconsolidated su
2 Limestone.
3 Hard trap rock; indu
volcanic ash.
4 Hard dark trap
sheared rock;
layered, sl
5 Limy shal
sandston
6 Shale
NOT
B
LEYTE
Probably
Tacloban
Legaspi
Palo
Tanauan
Dulag
Burauen
Carigara
Tabontabon
Tarragona
Abuyog
Baybay
Balocawe
Tunga
Jaro
Alajag
Mudburon
Marasbaras
Sta Fe
Sta Cruz
Malirong
Bolongtd
Kaghaly
Patong
Aguiting
Valencia
Cabulihan
Dolores
Patag
Ipil
Boroc
Pahagan
Balugo
Benulho
Albuera
Tabgas
Damulaan
(Damula-an)
Tinag-an
Caridad
Hilapnitan
San Augustin
Bartoline
Gabas
Punta
Catarman Pt
Bitahuan
(Bitanhuan)
Plaridel
Daquio I
(40)
Mahaba I
(137)
Cunalom
(Conalum)
Apit I
(150)
Inopacan
Amogotada Pt
Himuquitan I
(328)
Bulacan
Hindang
Binobolang Pt
Owak
Tugupa
Hilongos
Sto Niño
Alabat Pt
Capines Pt
Calianan Shs
Pinamitinan
Laua-an
Lauaan I
Lauaan Bay
Maglolo Bay
Aporoo I
Balusao
Osmeña
Caluwayan
Calogangan Pt
Camoropudan Is
Iris Shoal
San Pedro Bay
Egbert Shoals
Palo Reef
Binocyahan
Badunggabang Rock
Camiris Pt
Vigia Pt
Mariguitdaquit
Maguikay
Kiling
Daguitan
Telegrafo
Libas
Julita
Mat-i
San Roque
San Jose
Calbasag
Cabacungan
Rizal
Mayorgac
Bincay
Batog
Rangdan
Esperanza
Sta Ana
Andres
Pangasugan
Hitomnag
Guinarona
Mahidaom
Lubi
Capatgan
Matagpa
Gandonaya
Lake Danao
Lake Bito
Sungi
Bugho
Tahsayan
Palale
Hinoktogan
Buracan
La Paz
Calubugan
Tabunan
Tangbo Pt
Salacot Pt
Poldoc
Aslum
Taytay Pt
Dayas
Osmeña
Pagsayan
Lawaan
San Roque
Hinunucan Pt
Himamara
Humirog
Anibongon
Patong
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
(Lagome)
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Saingan Pt
Cabugan Chico I
Kanipaan (Canipa-an)
Hinunangan
Pandan Pt
Bugho Pt
Hibagwan
Guis
Malupao
Kadiad
Bagacay
Inalaran
Suba
Sogod
Consolacion
Malansa
Himakilo
Danan
Batuan
Guinsiliban
Cabayagon
Hubas
Mahanlag
Guinsonoan
San Juan
Gubang
Libagong
Union
Lubi
Matagpa
Sta Ana
Rizal
Mayorgac
Bincay
Tarragona
Abuyog
Tangbo Pt
Salacot Pt
Taytay Pt
Osmeña
Hinunucan Pt
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Saingan Pt
Cabugan Chico I
Kanipaan (Canipa-an)
Hinunangan
Pandan Pt
Bugho Pt
Gravel
MT. SAN MIGUEL
MT. BADIAN
MT. RIMA
MT. MAMBAN
MT. LAAD
ALTO PEAK
MT. JANAGDAN
MT. CANCAJANAG
MT. BANAO
MT. LOBI
MT. MAGONOG
MT. MAJUNAG
MT. CATMON
MT. CAANISILAGAN
MT. PALANAS
MT. TUNAS
MT. BATO
MT. TABAAN
MT. PANASUGAN
MT. MAGANIAN
MT. CALARABAYAN
MT. TINAGAN
MT. SACRIPANTE
MT. DAOGDAOG
MT. QUINASAGAN
MT. ILAYE
MT. BUYEBANG
MT. SOISOGON
MT. RANJONGON
MT. MILO
MT. ILIHAN
MT. NACOLOD
MT. ABUYOG
CATMON HILL
Lake Danao
Lake Bito
Tigbao R
Tinagong R
Tungud R
Binabaan
Yapad
Lauan
Tapkip
Patoc
Sta Elena
San Isidro
Hitomnag
Telegrafo
Tabontabon
Libas
Julita
Mat-i
Calbasag
Burauen
Andres
Pangasugan
Esperanza
Batog
Rangdan
Tulisan R
Maya R
Buracan
Calubugan
Hinoktogan
Palale
Tahsayan
Bugho
Sungi
Bito
Abuyog
Tangbo Pt
Salacot Pt
Poldoc
Aslum
Taytay Pt
Dayas
Osmeña
Pagsayan
Lawaan
San Roque
Hinunucan Pt
Himamara
Humirog
Anibongon
Patong
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Saingan Pt
Cabugan Chico I
Kanipaan
Hinunangan
Pandan Pt
Bugho Pt
Hibagwan
Guis
Malupao
Kadiad
Bagacay
Inalaran
Suba
Sogod
Consolacion
Malansa
Himakilo
Danan
Batuan
Guinsiliban
Cabayagon
Hubas
Mahanlag
Guinsonoan
San Juan
Gubang
Libagong
Union
Lubi
Matagpa
Sta Ana
Rizal
Mayorgac
Bincay
Tarragona
Abuyog
Tangbo Pt
Salacot Pt
Taytay Pt
Osmeña
Hinunucan Pt
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Saingan Pt
Cabugan Chico I
Kanipaan
Hinunangan
Pandan Pt
Bugho Pt
Gravel


Pambuhan Sur
(Pambujan Sur)
MT AMANGSARAHACAN
Vigan I
Anahao
Lalauigan I
Capocpocanan I
Matarinao Bay
Linoa I
Minaloa I
581
Minadion I
543
Matarinao
Kanadag I
Sisi I
Borak (Burac)
Asgad Pt
Caridad
San Pedro
Naga
Malbog
Panaon
Asgad
Pananamitan Pt
Sta Margarita I
Salcedo
950
940
1000
500
Giporlos
Balangiga
Onas I
Sua Bay
Sua Pt
Cabagnlio Pt
Cabarasan Pt
Balinatio I
Bobon
Mercedes
408
Bagtong Pt
Bobon Pt
Binabasalan I
Cantican
Canigaran I
Luyong Pt
Baul I
Borabo I
Tubabao I
345
Calicoan Pass
Cabalarian I
Caninoan
Tubabao
Cambasingan I
Guiuan
Barbo
Inatoulan I
Salug
350
Caantulan
534
Bar Islet
Raton Pt
Soroc
Manicani I
Manicani
Cabadlongan Pt
CALICOAN I
Banaag
Bares at low water
Suluan
Leleboon I (200)
Candolu I (188)
Sungi Pt
Handig Pt
Malapacao Pt
1120
Pamunacan Pt
Coracoraan Pt
1116
Habag
Montoconan I
Inapulangan
720
HOMONHON ISLAND
Malistis Pt
Casogoran Bay
Hinablan Pt
Paporan Pt
Kabungaan
Homonhon
Kanaoayong Pt
700
Kulasi
Cagosoan Pt
Pagbabangnan
Pagbabacnan Pt
Barapdaban Pt
Colasi Pt
204
Suluan I
340
Granadas
438
1350
11°00'
1300
30'
rficial deposits.
urated coarse and fine
G U L F
rocks; soft green
flaky, thin-
aty rocks.
e; limestone; shale;
e; minor trap rock.
, sandstone, conglomerate.
E: For detailed map explanation see San
ernardino Strait quadrangle map (ND 51-6).
PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY
Kanhandon Pt
Hibuson I
620
Kanlibud Pt
Little Hibuson I
Gibusong
Hibuson Pt
Tinaga Cove
Balukaui Pt
Looc Bay
Kanamong Pt
Desolation Pt
(120)
Masdang Cove
1420
Kayasa
Masdang Pt
Is
Panamaon
Babatnon Pt
1540
MT KANBINIIO
2980
Kalanugan Pt
Berrugosa Pt
(120)
Puyo
660
S T R A



A.M.S. S401

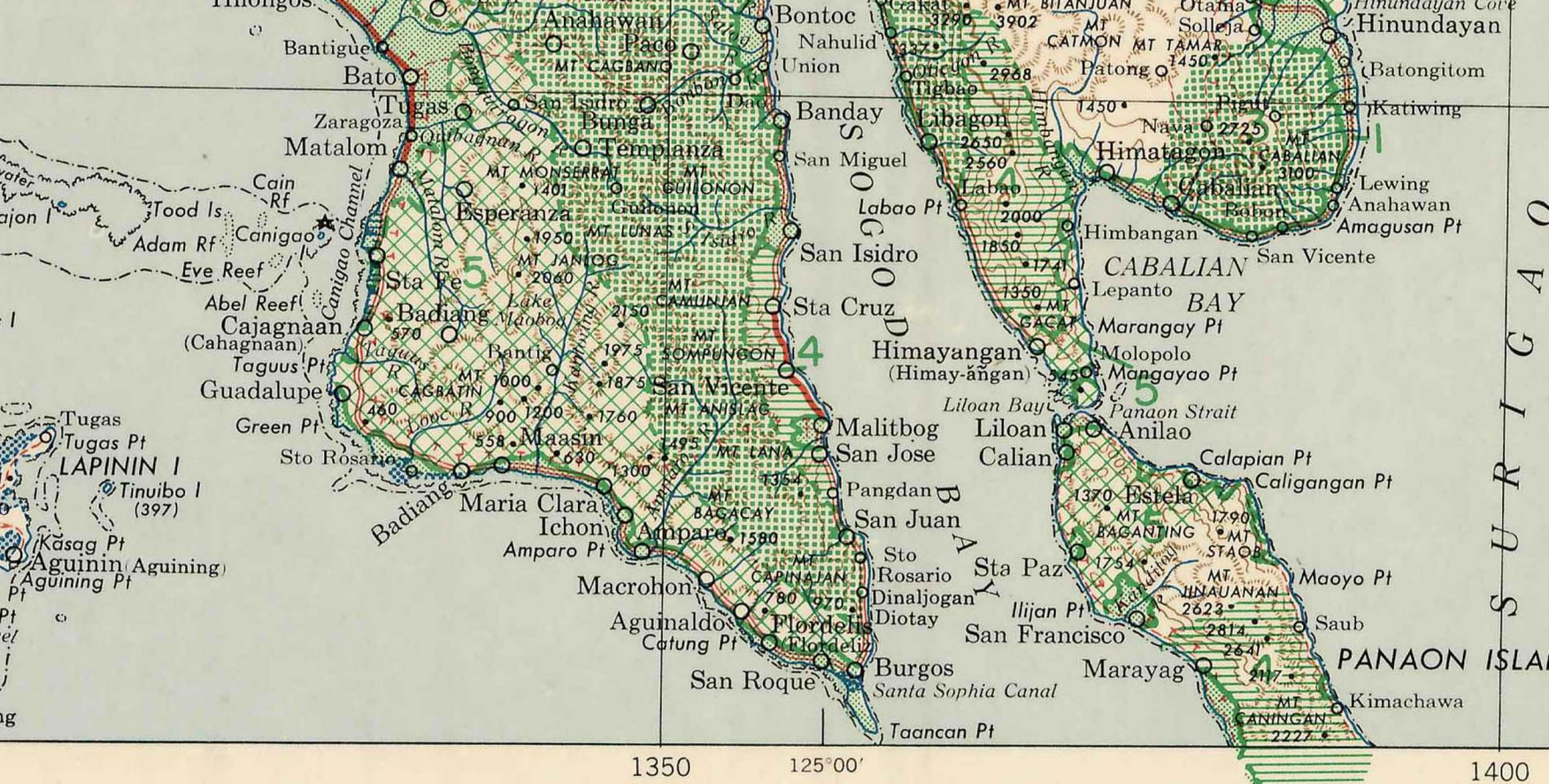
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D.
Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 193
1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippine
1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map of P
Samar Island, 1:63,360, O. C. E. O., Phil. Div., No. 1, 1908. Standard Recon. Map, Surigao & Augusan, 1:100,000, Inc. Co., No
I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road M
P. I., 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Ma
Philippines, 1:500,000, Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Hq.
Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, U
No. 100, 1933.

CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
500	2,000
	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

10000 0 10000 20000 30000 Yards

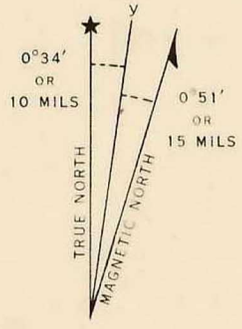
CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS WASHINGTON, D. C.

C., 1944.
36; 4422,
Islands,
Portion of
. 1. Vols.
Map of the
ap of the
Mil. Int.,
USC & GS,

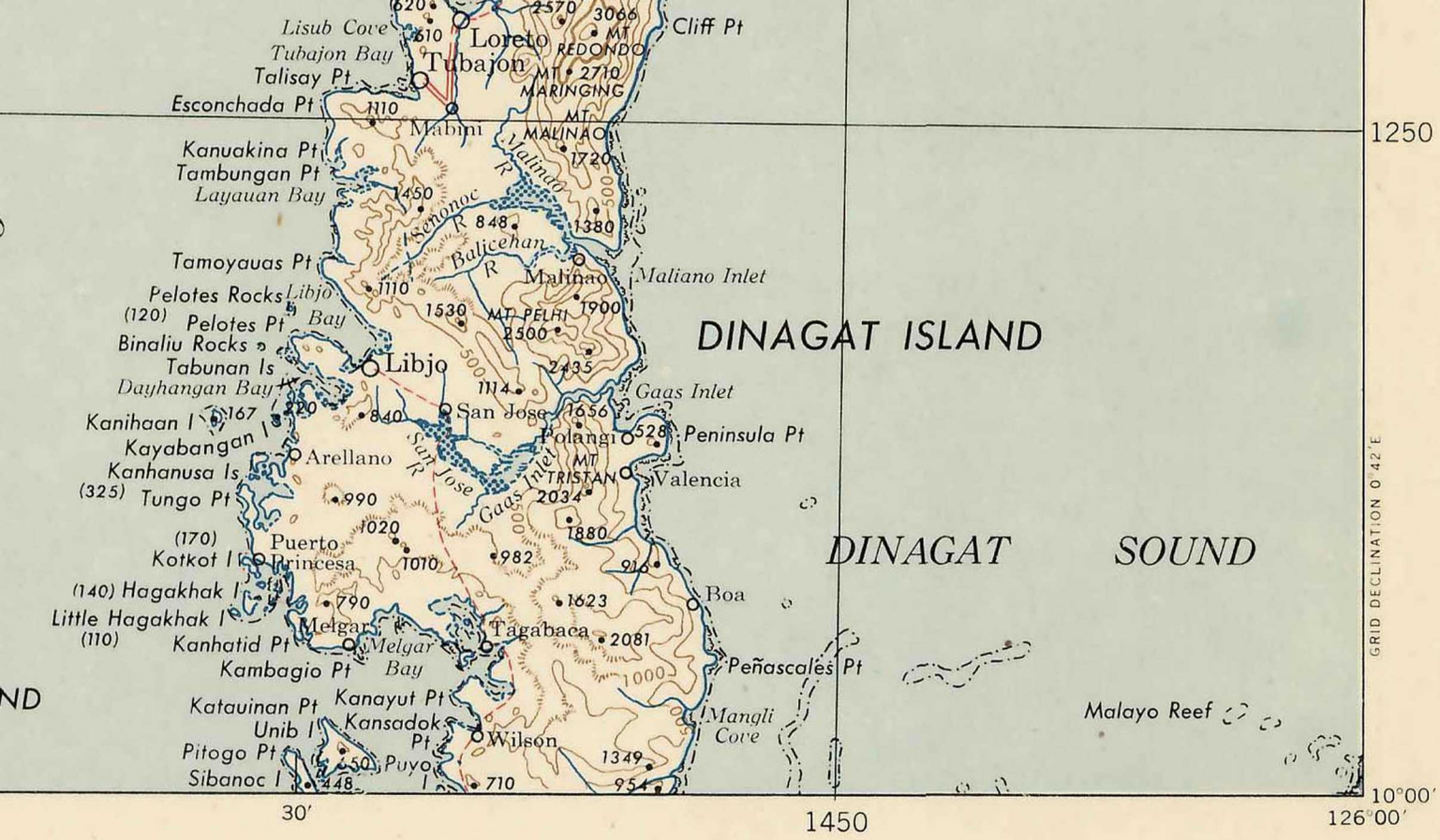


APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

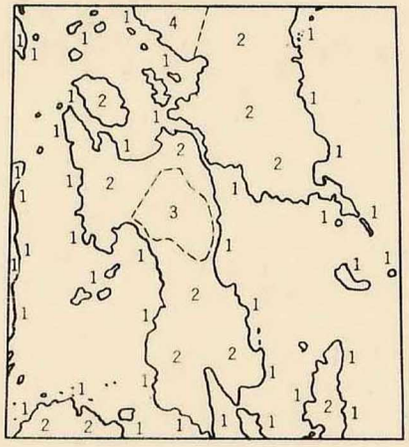
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS

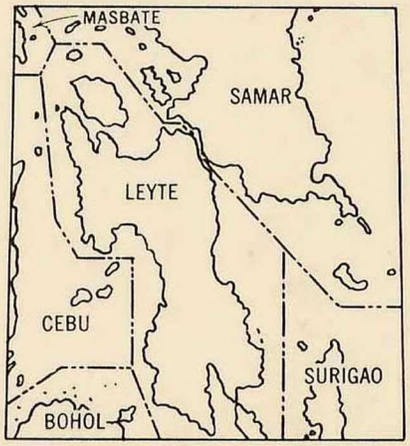


ARMY MAP SERVICE, U. S. ARMY, WASHINGTON D. C. 112094
9-44 1944

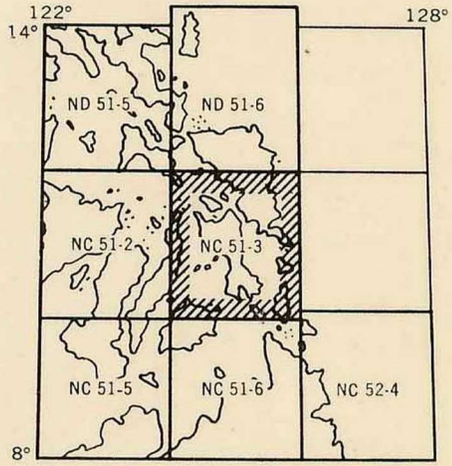
COVERAGE DIAGRAM



INDEX TO BOUNDARIES



INDEX TO ADJOINING SHEETS



1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

SAMAR AND LEYTE (P.I.)

CONSTRUCTION MATERIALS

Reliability: Northwest Leyte and Camotes Islands, Good; rest of area, Poor.

INTRODUCTION

Sand, gravel, and cobbles are suitable for concrete aggregate, road metal, base course, and surface course; readily available in most parts of Leyte but scarce in Samar. If derived from sound, hard rocks, they are unexcelled for these uses.

Coral reef limestone is easily accessible in many coastal areas. Fringing and offshore reefs may in part provide the most easily procured material, but reef limestone on land is commonly harder. The harder varieties of coral limestone are excellent for most construction uses. These and the massive limestones, which occur chiefly on Samar, are good sources of lime.

The deep soil cover and dense forest on most of the terrain greatly restrict rock outcrops. Soil on limestone, calcareous shale, and shale generally only a few feet deep. Limestone commonly outcrops conspicuously. Limy sandstone and pebble conglomerate may be weathered to depths of 20 feet or more. Soft, green, sheared rock (serpentine) and flaky, thin-layered, moderately lustrous, slaty rocks (argillite and schist) may be weathered to depths as great as 50 feet. Trap rocks may be weathered to depths of 50 feet to 100 feet. Outcrops of relatively unweathered rocks are generally confined to very steep slopes, cliffs, and deep stream gorges. In the following table only the fresh rocks are described.

Fresh, massive trap rock and the harder limestones (Units 2, 4, and 5) are excellent for most purposes. Trap rock is in part the best source for high-strength masonry. In general, the trap rocks are better suited for heavy loading; in many places they are not easily accessible because they are deeply weathered.

Near Villaba, on northwest Leyte, several small tar-saturated sand lenses are sources of bituminous surfacing material, but may now be exhausted. Four rock quarries are known on these islands; the material in at least two of them is useless for construction. A half mile west of Tenauan, on the east coast of Leyte, is an old quarry for road material in strongly sheared, soft, green rock (serpentine), probably unsatisfactory for construction. Nearby, at Palo, is another quarry for road material in strongly sheared, slaty rock, probably unsuited for construction. At Tacloban, is a quarry, use unknown, probably in limestone suitable for most uses. Municipal quarry near Anas Point, about 2 miles north of Catbalogan, Samar; probably in a hard, white limestone excellent for most uses. For timber for construction see Vegetation sheet.

Map Unit	Type of Material	Concrete Aggregate	Base Course, Surface Course, and Road Metal	Riprap	Masonry
1	Unconsolidated clay, sand, and gravel, locally bouldery. In places along coast, much interbedded coral rock. Predominantly clay and some sand on seaward parts of large coastal plains. Sand and gravel increase in abundance toward mountains; generally abundant along streams in and near mountains, and on beaches backed by cliffs or steep mountains. Gravel and sand between streams on sloping plains at foot of mountains may be weathered to soft, unsound material to depths of 50 feet or more.	Sound boulders, especially of trap rock, are excellent for coarse aggregate. Clean, poorly graded gravel and sand excellent for fine aggregate. Top 6 inches of gravel and sand deposits in flowing streams should be avoided; widespread green algae prevents bonding of aggregate, is not easily washed off. Hard coral limestone is excellent source.	Well-graded gravel and gravel-sand mixtures are best material for base course and surface course. Poorly graded gravel and sand can be stabilized with silty clay from lowlands	Boulders and hard coral limestone may be suitable.	Boulders and hard coral limestone may be suitable.
2	Limestone. Raised coral limestone, generally porous; in places well cemented and hard, in others soft and poorly consolidated, with large pieces of coral in cemented matrix of coral sand and gravel. Commonly material near surface is harder (casehardened) than material at depth of a few feet. Beds irregular but mostly only a few feet thick; locally interlayered with softer calcareous clay. On Samar, thin to thick-bedded limestone, massive, but in places cavernous. Usually hard, compact; locally interlayered with softer calcareous shale.	Harder varieties are excellent source.	Excellent for base course; calcareous clay and shale should be avoided. Harder varieties excellent for surface course and road metal.	Hard massive limestone is excellent source.	Some hard, massive limestone is suitable.
3	Hard trap rock (andesite), soft to hard volcanic ash (tuff), and blocks of trap rock in a matrix of trap rock or volcanic ash (agglomerate). Some trap rock is porous and slaggy. Rock may be weathered and unsound to depths of 50 feet to 100 feet, except on very steep slopes and deep stream gorges.	Fresh massive trap rock is excellent source.	Fresh massive trap rock is excellent source.	Much of trap rock may be too closely fractured or jointed; otherwise excellent source.	Most rock probably too closely fractured or jointed. Rock masses like that 1 1/2 miles east of Campopo Bay might be suitable.
4	Hard tough trap rock (gabbro, peridotite, basalt, andesite, and diorite); soft green sheared rock (serpentine); flaky, thin-layered, generally lustrous rocks (slaty rocks and schist). Commonly closely fractured; serpentine and slaty rocks commonly strongly sheared, unstable under load. Trap rocks generally weathered to depths as great as 50 to 100 feet below surface. Very few outcrops except on steep slopes or in deep stream gorges. Some fresh trap rocks (diorite and gabbro) are very dense, tough, hard rocks, excellent for heavy construction. Others (peridotite) are generally not well suited for construction. Slaty rocks, schist are generally poor but may be suitable for light construction.	Fresh massive trap rocks are an excellent source.	Fresh massive trap rocks are excellent source.	Fresh massive trap rocks are an excellent source, if not too closely fractured.	Locally, fresh massive trap rocks (especially diorite and gabbro) are excellent source.
5	Calcareous shale, moderately soft to hard limestone, hard to soft shale, and some pebble conglomerate. In addition, hard limy sandstone and small amounts of trap rock on Samar, northeast Leyte, and on Panaon Island.	Hard limestone is excellent source. Trap rock, if fresh, is probably good source. Hard calcareous sandstone and pebbles from conglomerate are fair source.	Hard limestone is excellent source. Trap rock probably is very good source. Hard calcareous sandstone and pebble conglomerate are fair materials for base course.	Hard limestone and trap rock are good sources.	Some hard limestone and possibly some trap rock is suitable.
6	Soft to firm shale; soft to fairly hard sandstone; local conglomerate and calcareous shale. Much of unit in northwest Leyte is soft, soapy shale; has tendency to swell when wet; is very unstable.	Conglomerate pebbles are fair local source.	Several tar-saturated and oil-saturated sandstone beds on northwest Leyte provide bituminous surfacing material. A bed, about a mile east of Balite, about 300 feet long and 50 feet thick, has been quarried for paving material. Conglomerate pebbles are fair source of road metal.	Not suitable.	Not suitable.

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army

SAMAR AND LEYTE(P.I.)

Rel

Sand, gravel, and cobbles are suitable for concrete aggregate, road metal, base course, and surface course; readily available in most parts of Leyte but scarce in Samar. If derived from sound, hard rocks, they are unexcelled for these uses.

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The deep soil cover and dense forest on most of the terrain greatly restrict rock outcrops. Soil on limestone,

[redacted] CONFIDENTIAL

iability: Northwest Leyte and Camotes Islands, Good; rest of area, Po

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Fresh, massive trap rock and the harder limestones (Units 2, 4, and 5) are excellent for most purposes. Trap rock is in part the best source for high-strength masonry. In general, the trap rocks are better suited for heavy loading

CONSTRUCTION MATERIALS

or.

in many places they are not easily accessible because they are deeply weathered.

Near Villaba, on northwest Leyte, several small tar-saturated sand lenses are sources of bituminous surfacing material, but may now be exhausted. Four rock quarries are known on these islands; the material in at least two of them is useless for construction. A half mile west of Tanauan, on the east coast of Leyte, is an old quarry for road material in strongly sheared, soft, green rock (serpentine), probably unsatisfactory for construction. Nearby, at Palo, is another quarry for road material in strongly sheared, slaty rock, probably unsuited for construction. At Tacloban, is a quarry, use unknown, probably in limestone suitable for most uses. Municipal quarry near Anas Point, about 2 miles

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	Concrete Aggregate	Base Cours and
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ous; in poorly ted al near depth few feet s clay. e, but lly inter-	Harder varieties are excellent source.	Excellent for ba clay and shale s er varieties exc course and road
ash ap rock porous depths es and	Fresh massive trap rock is excellent source.	Fresh massive tra source.
ande- ntine); ty rpen- stable ths as utcrops Some se, n.	Fresh massive trap rocks are an excellent source.	Fresh massive tra source.

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se, Surface Course, Road Metal	Riprap	Masonry
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p rocks are excellent	Fresh massive trap rocks are an excellent source, if not too closely fractured.	Locally, fresh massive trap rocks (especially diorite and gabbro) are excellent source.

	...others (peridotite) are generally not well suited ... construction. Slaty rocks, schist are generally po... may be suitable for light construction.
5	Calcareous shale, moderately soft to hard limeston... to soft shale, and some pebble conglomerate. In a... hard limy sandstone and small amounts of trap rock... Samar, northeast Leyte, and on Panaon Island.
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for or but		
e, hard ddition, on	Hard limestone is excellent source. Trap rock, if fresh, is probably good source. Hard calcareous sandstone and pebbles from conglomerate are fair source.	Hard limestone is Trap rock probabl Hard calcareous s conglomerate are base course.
local n to	Conglomerate pebbles are fair local source.	Several tar-satur sandstone beds on vide bituminous s bed, about a mile about 300 feet lo has been quarried Conglomerate pebb of road metal.

CONFIDENTIAL

excellent source. y is very good source. andstone and pebble fair materials for	Hard limestone and trap rock are good sources.	Some hard limestone and possibly some trap rock is suitable.
ated and oil-saturated northwest Leyte pro- urfacing material. A east of Balite, ng and 50 feet thick, for paving material. les are fair source	Not suitable.	Not suitable.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army

PHILIPPINE ISLANDS 1:500,000

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SAN BERNARDINO STRAIT

SECOND EDITION-AMS 2

ND 51-6

GEOLOGY

SAMAR AND LEYTE(P.I.)

EXPLANATION

1. Alluvium (Recent): Unconsolidated gravel, sand, silt and clay. Along portions of the coastal strip includes some raised coral reefs.
2. Raised reef limestone (Quaternary): Coral-reef limestone, generally hard, well consolidated, locally poorly consolidated; some calcareous clay.
3. Leyte group (Upper Miocene-Lower Pliocene): Calcareous shale, locally bentonitic shale, limestone, in part corralline, and some sandstone. Highly variable in thickness and lithology.
4. Tagnocot shale (Miocene): Firm dark gray or bluish shale, with a few coarse sandstone lenses.
5. Catbalogen formation (Miocene): Gray calcareous shale (Marl), siltstone, sandstone, and conglomerate. At least in part, same age as Tagnocot.
6. Taog formation (Oligo-Miocene to Miocene): Mainly well-bedded brown sandstone with local conglomerate, some black carbonaceous shale with coal stringers.
7. Daram formation (Oligo-Miocene to Miocene?) Hard, calcareous, coarse to fine-grained sandstone; pebble conglomerate; hard, black shale. Some hard orbitoidal limestone and interbedded soft to hard calcareous shale (marl). Locally, intrusives, flows, and fragmental deposits of andesitic rocks. In part, equivalent in age to Taog formation.
8. Volcanics (Oligo-Miocene to Recent): Andesite flows, coarse intrusives, tuff and agglomerate.
9. Basic Igneous and metorphic complex (Pre-Oligo-Miocene, some younger rocks): Basalt, diorite, gabbro, peridotite; serpentine, argillite, and schist. In places much sheared.

No data available

Definite contact

Approximate contact.

PREPARED BY U. S. GEOLOGICAL SURVEY FOR CHIEF OF ENGINEERS, U. S. ARMY

NORTH PACIFIC OCEAN

MAQUEDA CHANNEL

CATADUANES ISLAND

LAGONOY GULF

ALBAY GULF

SAMAR SEA

LUZON

SAMAR

BALICUATRO ISLANDS

BATAN I

RAPU RAPU I

BATAG I

LAOANG I

NARANJO ISLANDS

CAPUL I

DALUPIRI

MASBATE ISLAND

TAGAPULA ISLAND

Reliability: Poor

1 250 000 YARDS

1 500 000 YARDS

A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.
Compiled from: Sectional Aeronautical Chart, 1:500,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1932; No. 13, 1940, Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1908. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., Pr. 1, 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Ho. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

CONVERSION GRAPH NOT at the scale of the map. Meters / Feet

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge, with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric (ELECTRIFIED)
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance
- City, Second Importance
- City or Large Town
- Small Town
- Village or Settlement
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove

MANILA
DAVAO
Tagum
Peña
Kalan

82

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles
10 8 6 4 2 0 10 20 30 Kilometers
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID. THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET. ANNUAL MAGNETIC CHANGE 1° INCREASE. Do not use diagram except to obtain numerical value of angles

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliability fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:500,000 (Compiled map - reliability fair)

PROVINCES
1. ALBAY
2. SORSOGON
3. SAMAR
4. MASBATE

Broken Shorelines Indicate Mangrove

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1:2090 9-44 1944

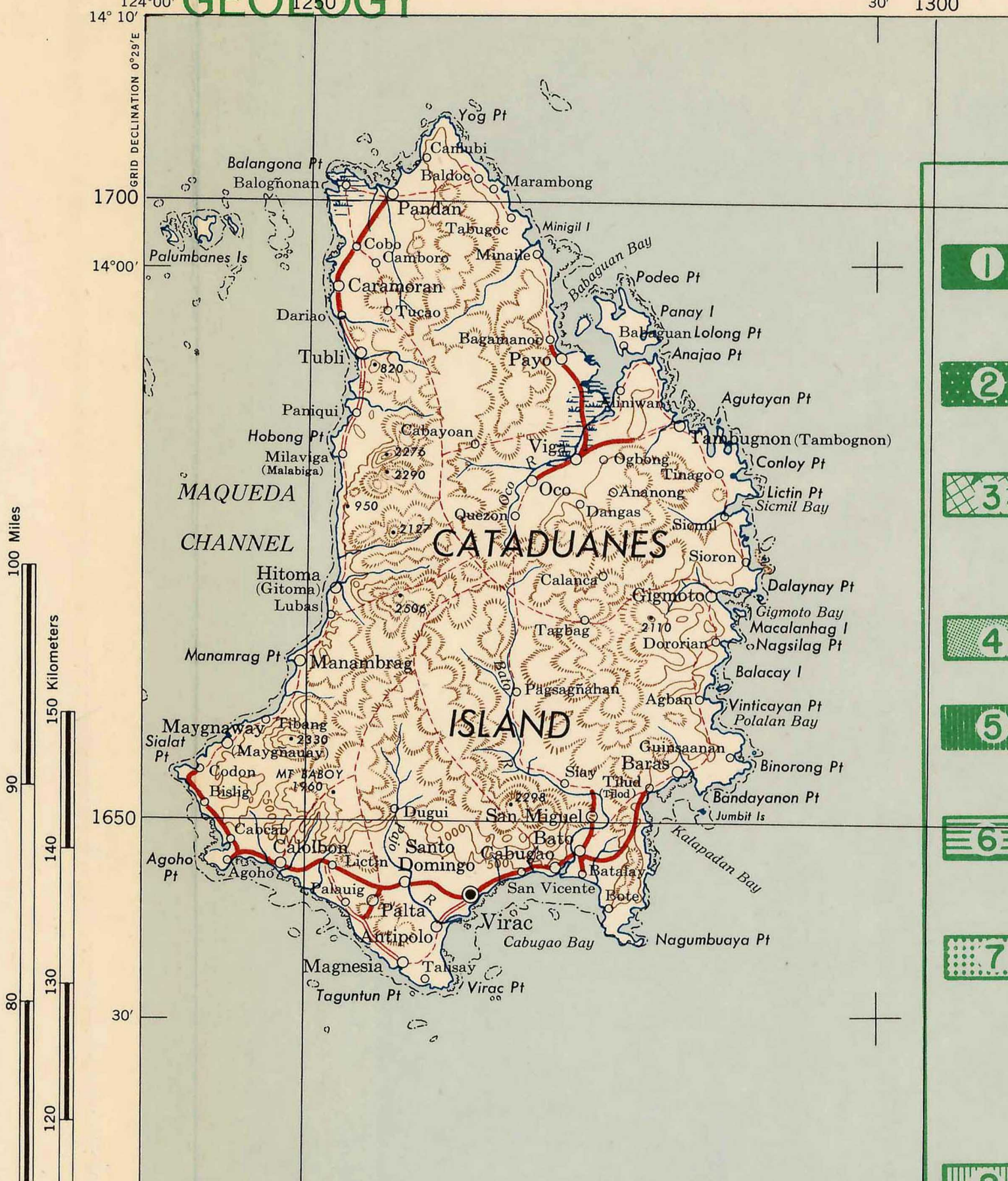
SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

PHILIPPINE ISLANDS 1:500,000

GEOLOGY

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n

SAN BERNARDINO STRAIT

1350 125°00′

EXPLANATION

Alluvium (Recent): Unconsolidated gravel, sand, silt and clay. Along portions of the coastal strip includes some raised coral reefs.

Raised reef limestone (Quaternary): Coral-reef limestone, generally hard, well consolidated, locally poorly consolidated; some calcareous clay.

Leyte group (Upper Miocene-Lower Pliocene): Calcareous shale, locally bentonitic shale, limestone, in part corralline, and some sandstone. Highly variable in thickness and lithology.

Tagnocot shale (Miocene): Firm dark gray or bluish shale, with a few coarse sandstone lenses.

Catbalogen formation (Miocene): Gray calcareous shale (Marl), siltstone, sandstone, and conglomerate. At least in part, same age as Tagnocot.

Taog formation (Oligo-Miocene to Miocene): Mainly well-bedded brown sandstone with local conglomerate, some black carbonaceous shale with coal stringers.

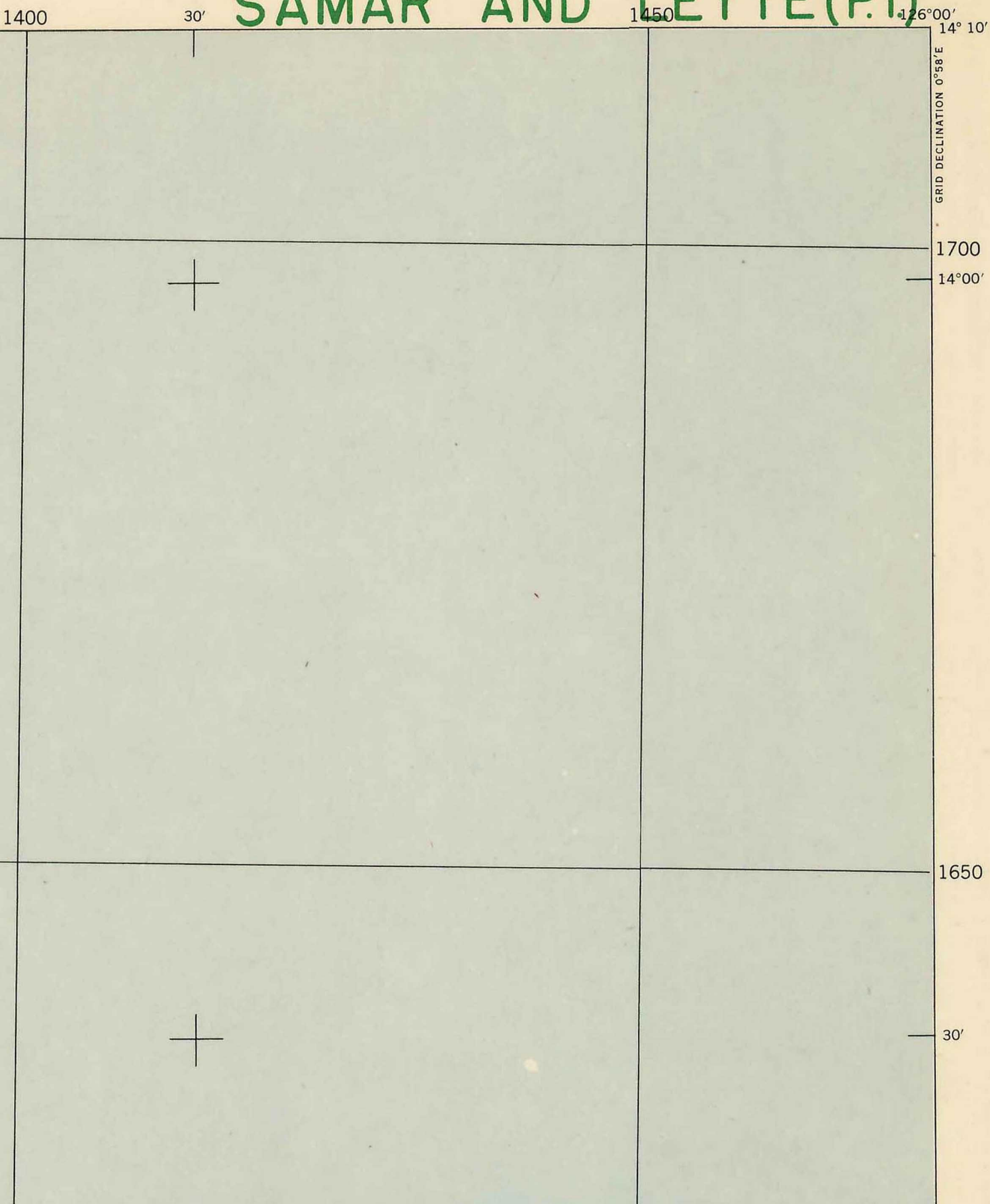
Daram formation (Oligo-Miocene to Miocene?) Hard, calcareous, coarse to fine-grained sandstone; pebble conglomerate; hard, black shale. Some hard orbitoidal limestone and interbedded soft to hard calcareous shale (marl). Locally, intrusives, flows, and fragmental deposits of andesitic rocks. In part, equivalent in age to Taog formation.

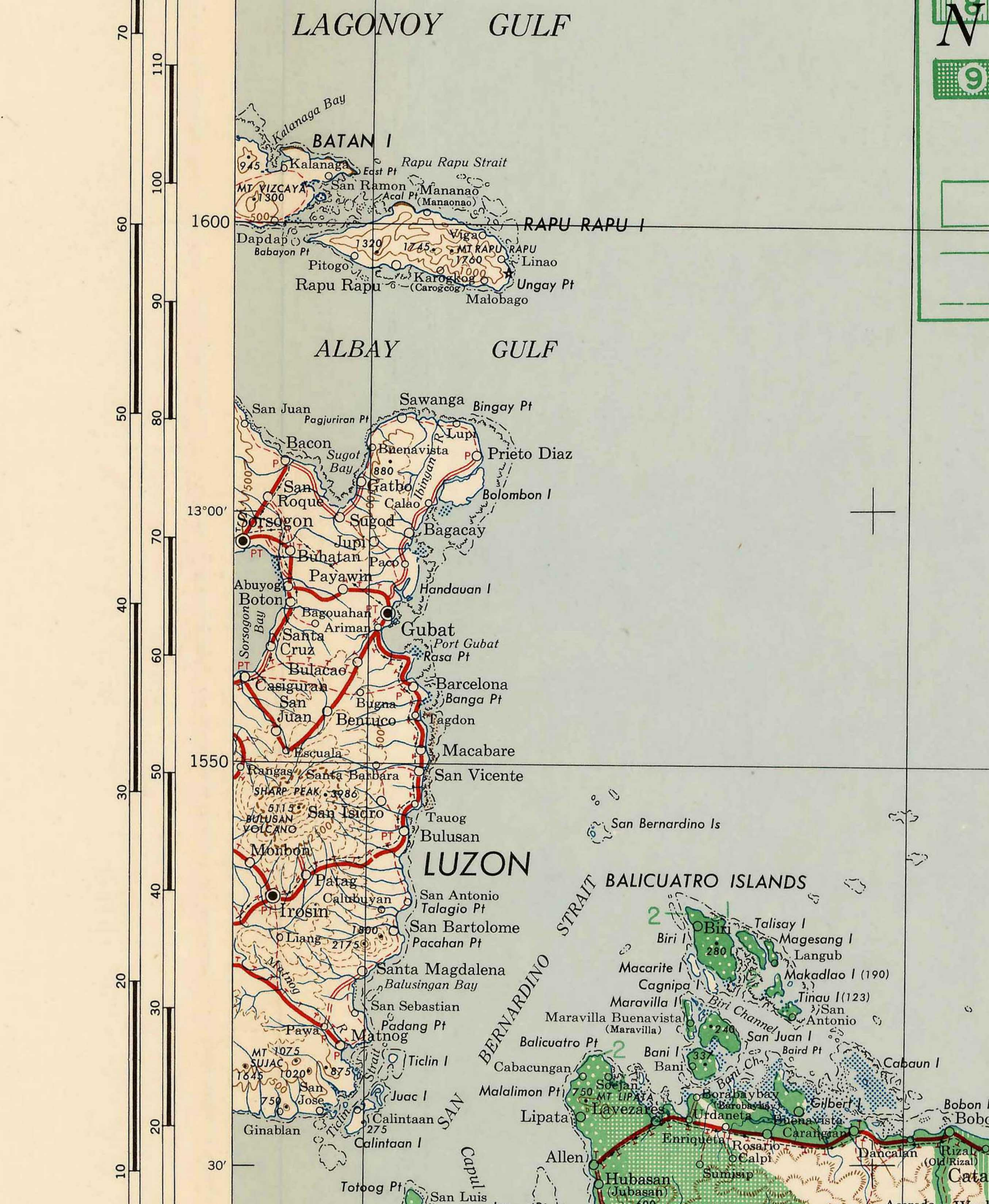
Volcanics (Oligo-Miocene to Recent): Andesite flows,

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE(P.I.)




LAGONOY GULF
Kalanaga Bay
BATAN I
Rapu Rapu Strait
Kalanaga
East Pt
MT VIZCAYA
1300
San Ramon
Acal Pt
Mananao
(Manaonao)
1600
RAPU RAPU I
Dapdap
Babayon Pt
1320
1745
MT RAPU RAPU
1760
Viga
Linao
Pitogo
Karogkog
(Carogcog)
Ungay Pt
Rapu Rapu
Malobago
ALBAY GULF
San Juan
Pagjuriran Pt
Sawanga
Bingay Pt
Lupi
Bacon
Sugot Bay
Buenavista
Ibinigan R
Prieto Diaz
880
San Roque
Gatbo
Calao
Bolombon I
13°00'
Sorsogon
Sugod
Bagacay
Jupi
Buhatan
Paco
Payawin
Handauan I
Abuyog
Boton
Bagouahan
Ariman
Gubat
Port Gubat
Rasa Pt
Sorsogon Bay
Santa Cruz
Bulacao
Casiguran
Barcelona
Banga Pt
San Juan
Bugna
Bentuco
Tagdon
Escuala
Macabare
1550
Rangas
Santa Barbara
San Vicente
SHARP PEAK 3986
8115
BULUSAN VOLCANO
San Isicro
Tauog
Bulusan
San Bernardino Is
Monbon
LUZON
Patag
San Antonio
Calubuyan
Talagio Pt
Irosin
San Bartolome
1800
Liang
2175
Pacahan Pt
Santa Magdalena
Balusingan Bay
Matnog
San Sebastian
Padang Pt
Pawa
Matnog
MT 1075
SUJAC
1645
1020
875
Ticlin I
Ticlin Strait
San Jose
750
Juac I
Calintaan
275
Calintaan I
Ginablan
SAN BERNARDINO STRAIT
BALICUATRO ISLANDS
Biri
Talisay I
Biri I
Magesang I
280
Langub
Macarite I
Makadlao I (190)
Cagnipa I
Tinau I (123)
Maravilla I
Biri Channel
San Antonio
Maravilla Buenavista
(Maravilla)
240
San Juan I
Balicuatro Pt
Bani I
337
Baird Pt
Cabaun I
Cabacungan
Bani
Sojan
Malalimon Pt
750
MT LIPATA
Borabaybay
(Barobaybay)
Gilbert I
Lavezares
Lipata
Urdaneta
Buenavista
Bobon
Caranggan
Enriqueta
Rosario
Calpi
Dancalan
Rizal
(Old Rizal)
Allen
Sumisip
Hubasan
(Jubasan)
Totoog Pt
San Luis
Capul I
30'
10
20
30
40
50
60
70
80
90
100
110

cores, intrusives, tuffs and agglomerate.

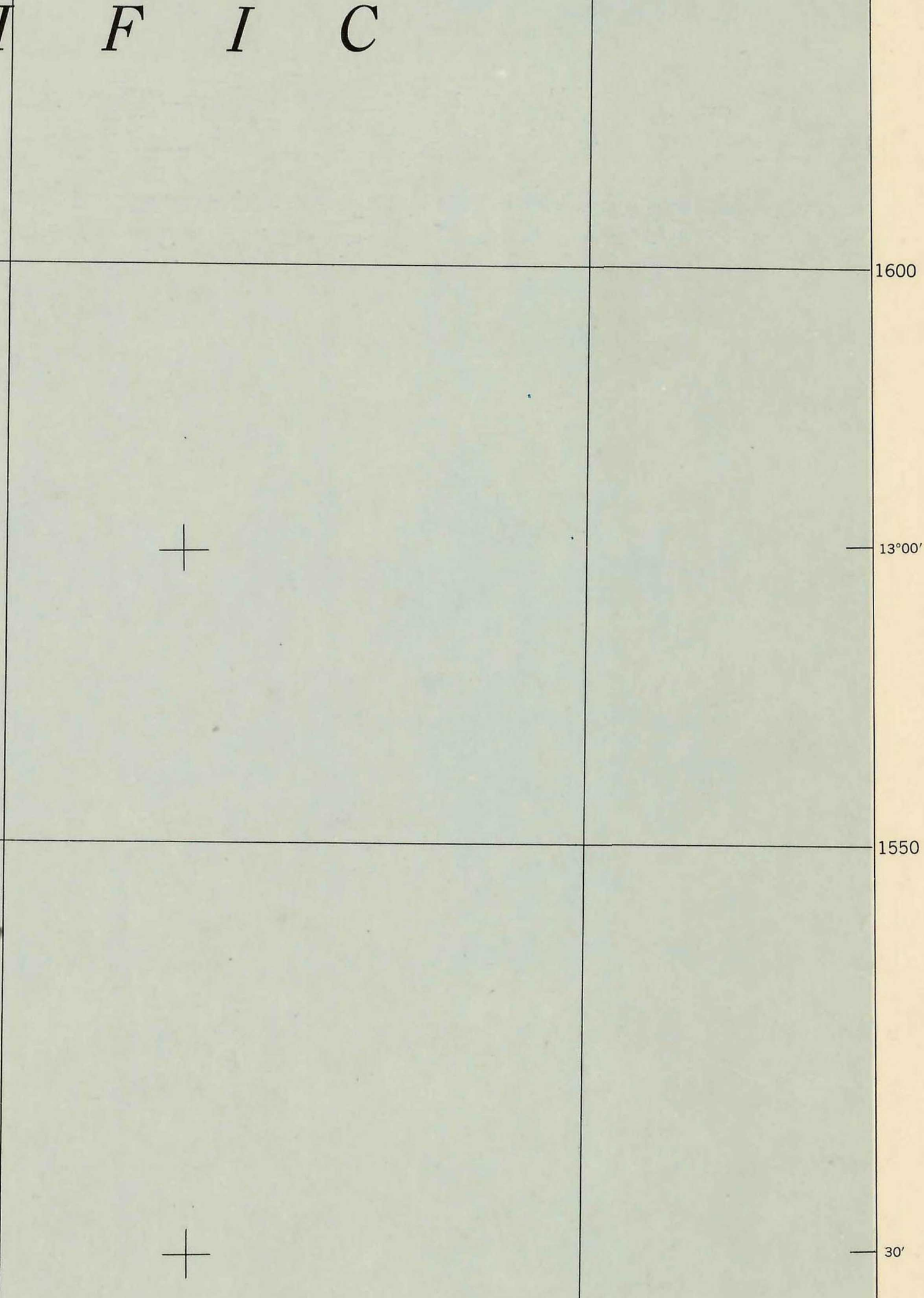
Basic Igneous and metorphic complex (Pre-Oligo-Miocene, some younger rocks): Basalt, diorite, gabbro, peridotite; serpentine, argillite, and schist. In places much sheared.

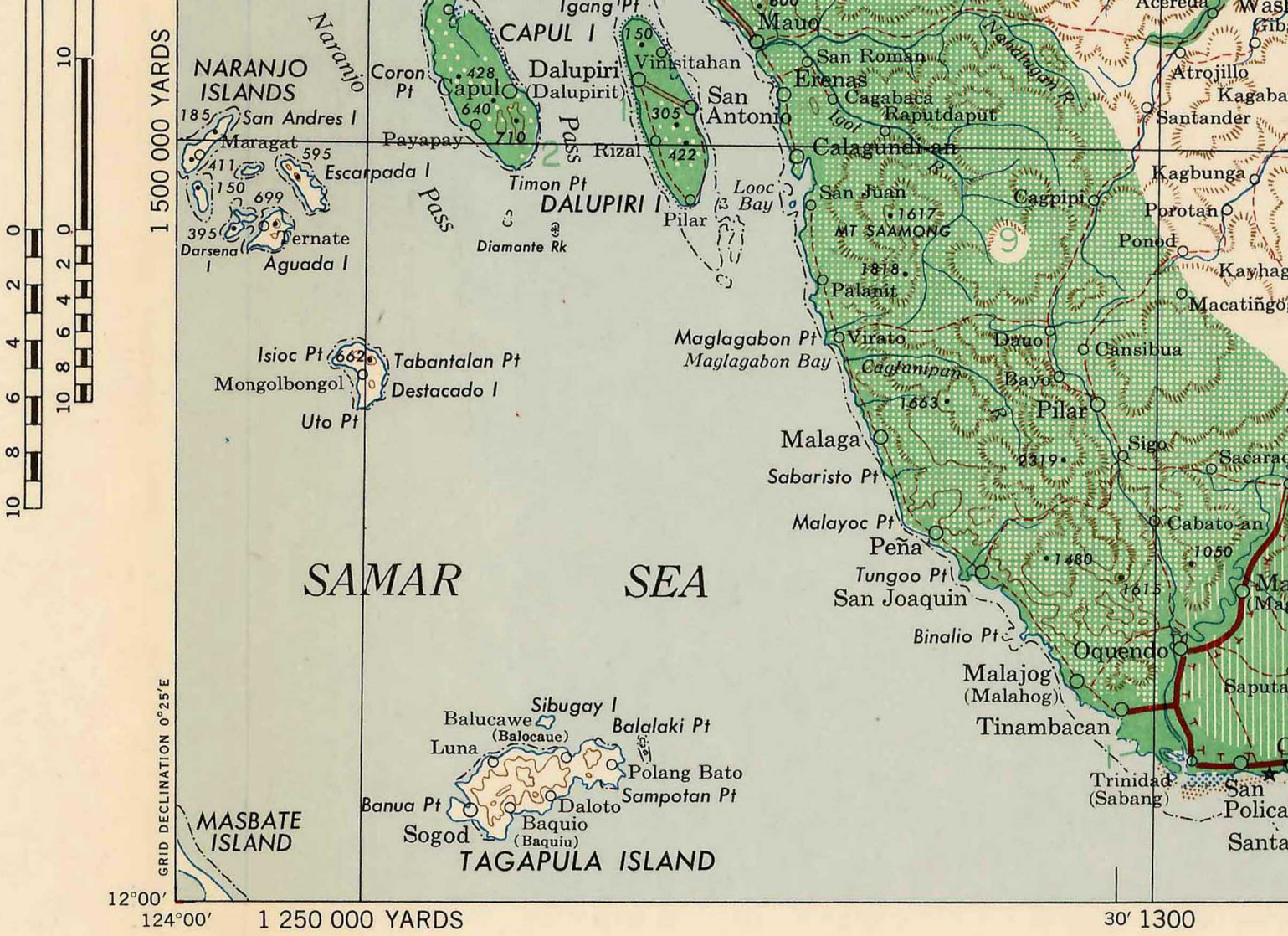
No data available

—— Definite contact

- - - Approximate contact.

PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY


F I C
1600
13°00′
1550
30′



A.M.S. S401
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.

Compiled from: Sectional Aeronautical Chart, 1:600,000, USC & GS, No. 2 1941. USC & GS Charts, 1908-1941. Philippine Islands: 1:200,000 USC & GS, No. 9, 1933; No. 12, 1932; No. 13, 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., Nos. 1 & 2, 1908. Luzon Oil Map, 1:200,000, National Development Co., 1940. Volumes I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Road Map of the Philippines, 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000, Bur. Pub. Works, Nos. 5 & 7, 1941. Telephone & Telegraph from: Communication Map of the Philippine Islands, 1:400,000, Hq. Mil. Int., Phil. Dept., 1931 (Corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

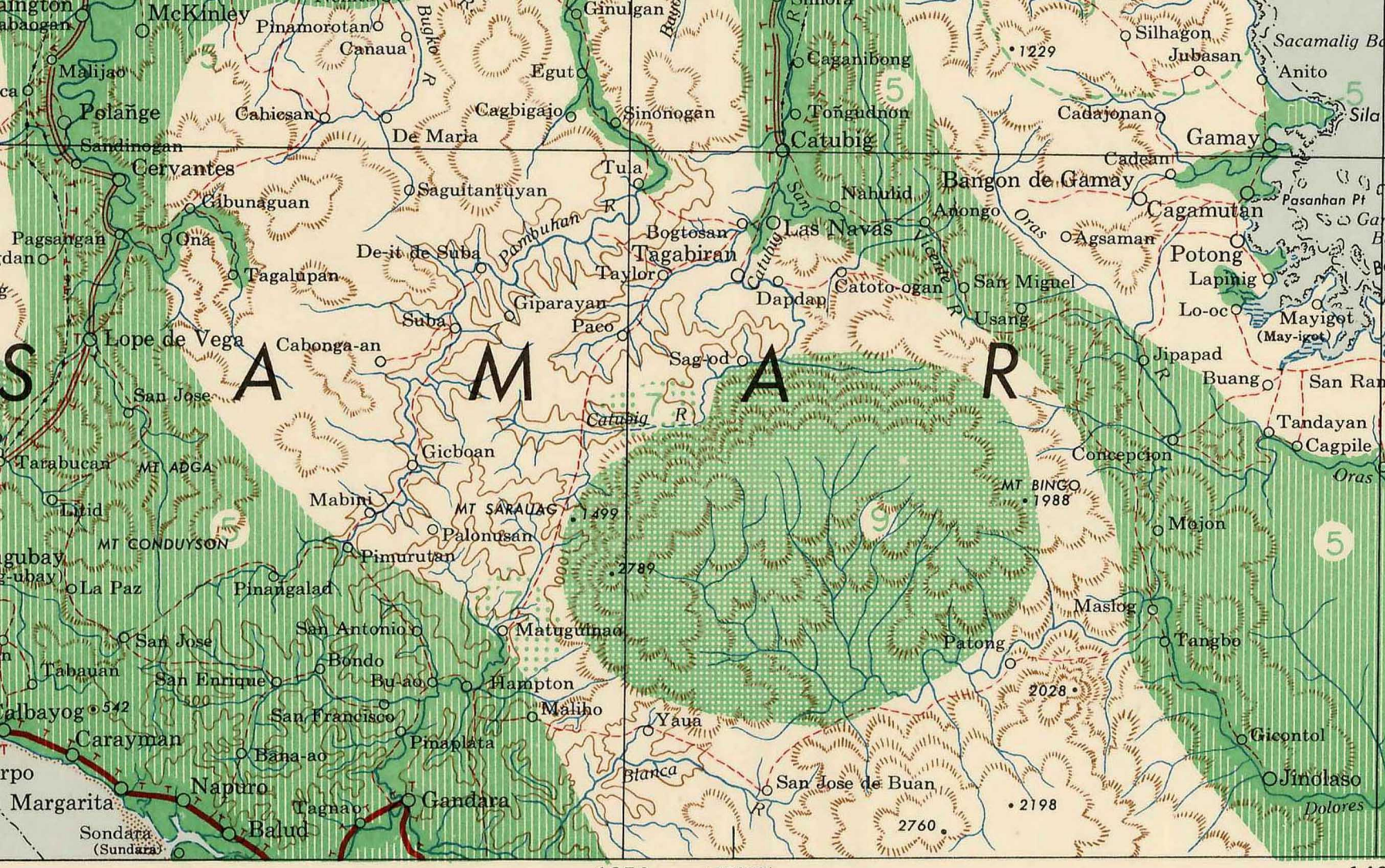
CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
	2,000
500	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line

- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station
- Mud Flat, Tidal Flat
- Mangrove



1350 125°00′ 140

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

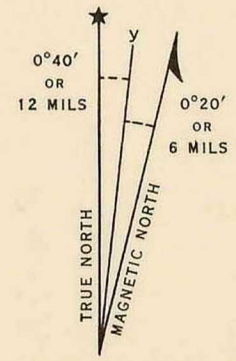
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

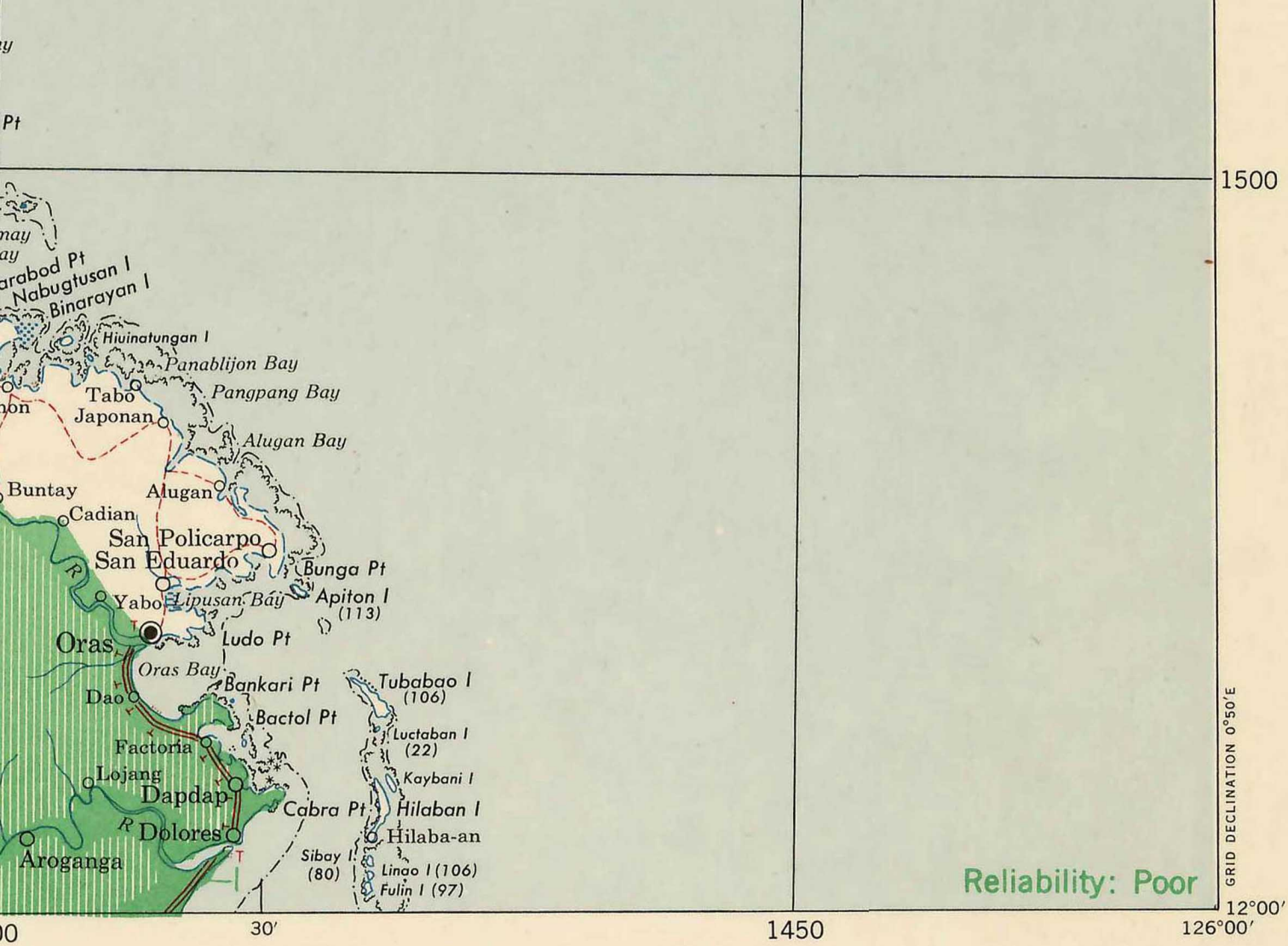


APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1′ INCREASE

Do not use diagram except to obtain numerical value of angles

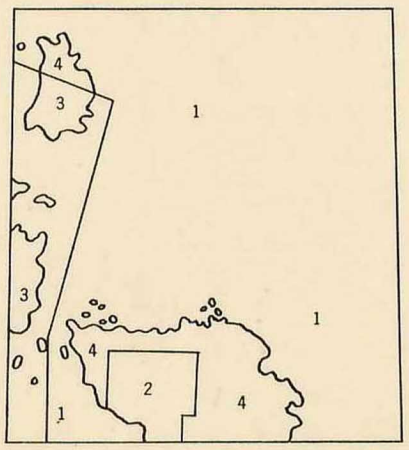
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS



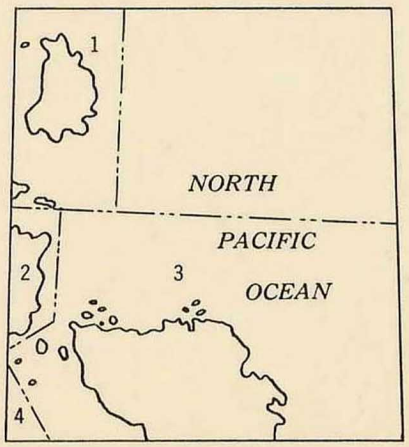
ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090
9-44 1944

COVERAGE DIAGRAM



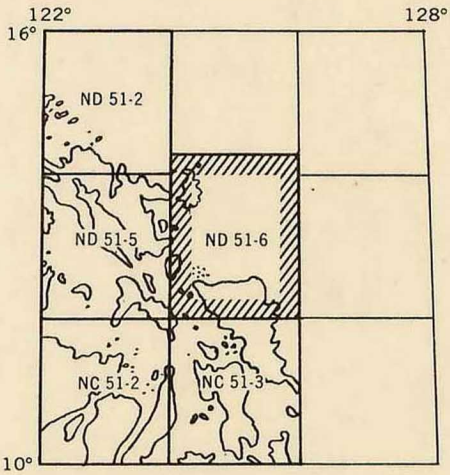
1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliabilty fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

INDEX TO BOUNDARIES



PROVINCES
1. ALBAY
2. SORSOGOR
3. SAMAR
4. MASBATE

INDEX TO ADJOINING SHEETS



Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

[redacted]

PHILIPPINE ISLANDS 1:500,000

GEOLOGY

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LEYTE ISLAND

SECOND EDITION-AMS 2

NC 51-3

SAMAR AND LEYTE(P.I.)

RELIABILITY: Northwest Leyte and Camotes Islands Good; remainder of area, Poor.



A.M.S. S401

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CONVERSION GRAPH NOT at the scale of the map.

Meters / Feet

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET. ANNUAL MAGNETIC CHANGE 1° INCREASE

Do not use diagram except to obtain numerical value of angles

NOTE: OFFICERS USING THIS MAP WILL MAKE HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND REPORT DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 1/12/44
S-44

Broken shorelines indicate mangrove

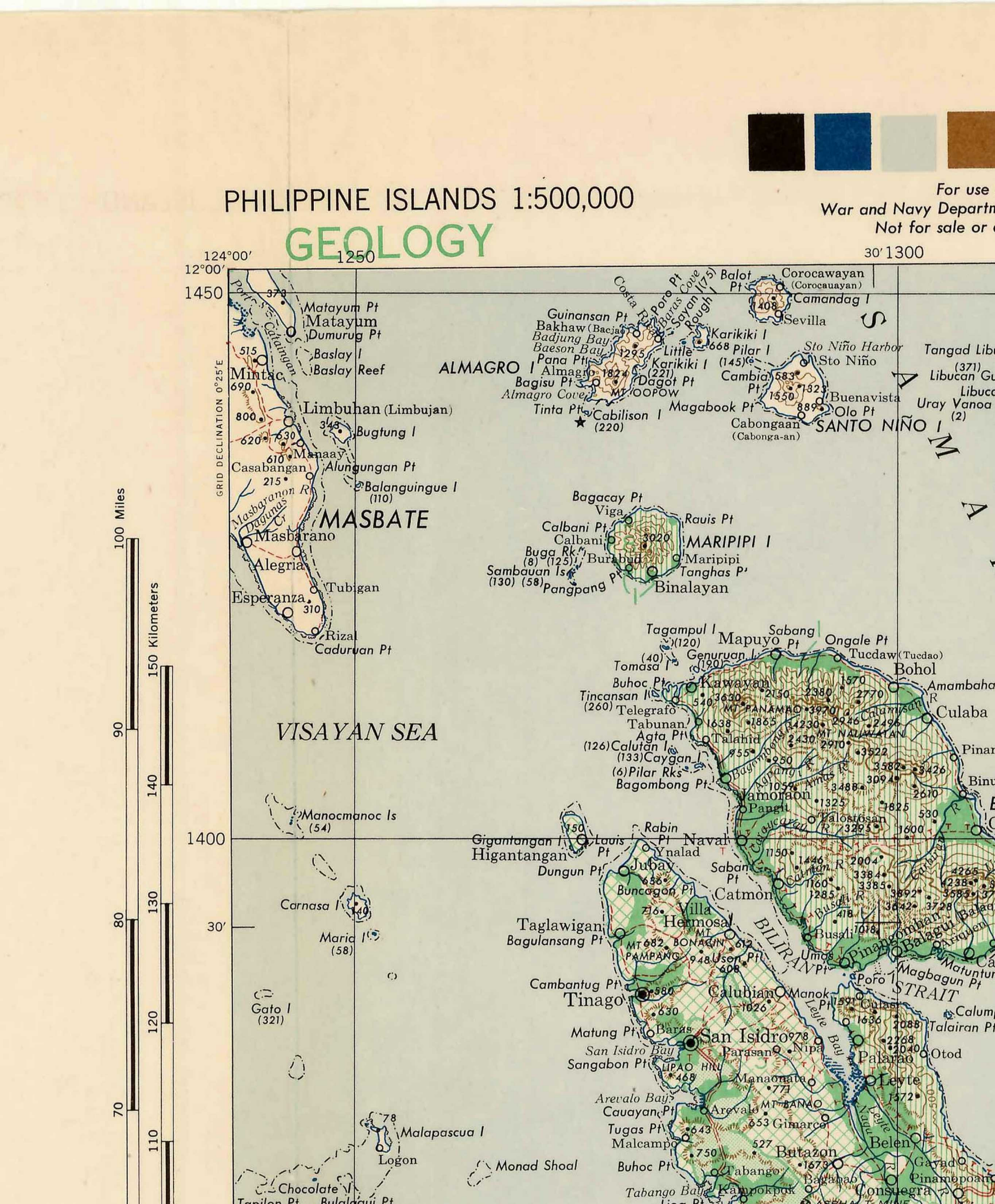
LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

PHILIPPINE ISLANDS 1:500,000

GEOLOGY



[redacted]

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LEYTE ISLAND


1350
125°00'
140
Sondara I
Napalisan Is
Caprangasan
Caprangasan Pt
Cambay I
Bangon I
Goyam I
Ravis Pt
Tarangnan
Libucan
Libucan I
Tagdaranao
Lunod Rk
Laylaya Is
Dapdap Rks
Cambidsos Rks
Tangad I
Borobaloto Rk
Timpasan I
Canahauan
Islands
Pagsanjan
Pagsanghan
Dapdap
Sta Cruz
Tarangnan Pt
Canawayan Is
Mangcares Pt
Canmamot I
Canahauan Daco I
Canahauan Gutiay
Sierra
Batgongon I
Bolo Rk
Balading I
Cambaloi I
Cagdullon
Ari I
Concepcion
Sah Luis
S Jorge
Bulao
Blanca Aurora
Catundan
Hinica-an
Cantaguic
Janipon
Calape
Paco
Palencia
Hernandez
San Fernando
Aibalate
Malino
Lolugayan
Morocoro Pt
Irongirong Pt
Silanga
Buri I
Buri
Anas Pt
Gatbalogan
Motiong
Inalad
Wright
Lutao
North Channel
South Channel
Reefs
Itihan Pt
Malubago
Jiabong Pt
Pangdan
Madalond Pt
Maqueda Bay
Hinabangan
San Sebastian
Jitaasan
Hita-asan
Patong
Calaya-an
Calbiga
Timpo
Pasigay
Villareal Bay
Buad Channel
Zumarraga
Buad I
Poro I
Marapilit I
Gaang Pt
Bataira
Daco I
Channel
Bay
Astorga
Biranan
Daram
Halaba Pt
Batubaruy Bay
Yagbungan Pt
Dormiri Bay
Badian I
Bakhaw Pt
Naparican Pt
Sua Bay
Sua
Aocon
Banquel
Baclayan
Lamingau
Bagacay
Guintarcan
Quindoc I
Buaya
Mabini
Laquinit
Olayan
Villareal
San Fernando
Lale
Monoc
Calubian Pt
Burgos
Bacsal Is
Daram Channel
Talalora
Dulugdug Pt
Nabatas Pt
Diutay Pt
Malagining Pt
Janabatas Channel
Calaguan
Canauay
Dabun I
Baluarte Pt
Kalangawan
Nabung Cove
Babatngon
Caltagan I
Navahay I
Candayo Pt
Baco
Malibago
Bino-ongan
Plandel
Tolosay
Sta Rita
Anibuangan Eduardo
Tomandog (Anibongon)
Manunca
La Paz
Bagalibas
(Bagolibas)
Pinogahan
Soholton
Mulbug
Sta Elena
Buenavista
New San Agustan
Balayon
Burgos
Nouvilas
Basey
Oce
Magallanes
Sta Cruz
Banug Pt
San Isidro
Uban Pt
Duka
Impo
Barugo
Culasian Pt
Calingcaguing
Carigara
Ibug Lake
Kabalawan
Cabalawan
Mongabong
Lukay
Amahit
Canoocan
Tinaogan
Basiao Is
Longeb Pt
Majaba I
Parasan I
Parasan Pt
Zumarraga
Mandagaran
Daco I
Astorga
Biranan
Daram
Sumuhit Pt
Sumuhit Bay
Patabunan Rf
Canauayan Bay
San Jose
Ginlantuyan Pt
Cahuayan
Little Darajuay I
Darajuay I
Malutugaul
Taratara
Rizal I
Cabitunang Pt
Danaodanauan I
Malayoc Pt
Pt
Maja-as
Tinaogan
Longeb Pt
Majaba I
Basiao Is
Jitaasan
Hita-asan
Gaang Pt
Marapilit I
Poro I
Pasigay
Calaya-an
Patong
Abaca
Buluan
Jubasan
Timpo
Calbiga
Villareal Bay
Buad Channel
Zumarraga
Quindoc I
Guintarcan
Buaya
Monoc
San Fernando
Lale
Olayan
Mabini
Laquinit
Bino-ongan
Plandel
Tolosay
Sta Rita
Anibuangan Eduardo
Tomandog (Anibongon)
Manunca
Mulbug
Pinogahan
Soholton
La Paz
Bagalibas
(Bagolibas)
Malibago
Baco
Candayo Pt
Caltagan I
Navahay I
Babatngon
Nabung Cove
Kalangawan
Baluarte Pt
Calaguan
Canauay
Dabun I
Janabatas Channel
Malagining Pt
Diutay Pt
Nabatas Pt
Dulugdug Pt
Talalora
Daram Channel
Bacsal Is
Calubian Pt
Burgos
Olayan
Villareal
Monoc
Buaya
Guintarcan
Quindoc I
Bagacay
Baclayan
Lamingau
Banquel
Aocon
Sua
Naparican Pt
Sua Bay
Bakhaw Pt
Badian I
Dormiri Bay
Yagbungan Pt
Batubaruy Bay
Halaba Pt
Daram
Biranan
Astorga
Ginlantuyan Pt
San Jose
Canauayan Bay
Patabunan Rf
Sumuhit Pt
Sumuhit Bay
Parasan
Parasan I
Parasan Pt
Zumarraga
Tinaogan
Longeb Pt
Majaba I
Basiao Is
Jitaasan
Hita-asan
Patong
Calaya-an
Calbiga
Timpo
Pasigay
Villareal Bay
Buad Channel
Zumarraga
Buad I
Poro I
Marapilit I
Gaang Pt
Bataira
Daco I
Channel
Bay
Astorga
Biranan
Daram
Halaba Pt
Batubaruy Bay
Yagbungan Pt
Dormiri Bay
Badian I
Bakhaw Pt
Naparican Pt
Sua Bay
Sua
Aocon
Banquel
Baclayan
Lamingau
Bagacay
Guintarcan
Quindoc I
Buaya
Mabini
Laquinit
Olayan
Villareal
San Fernando
Lale
Monoc
Calubian Pt
Burgos
Bacsal Is
Daram Channel
Talalora
Dulugdug Pt
Nabatas Pt
Diutay Pt
Malagining Pt
Janabatas Channel
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Canauay
Dabun I
Baluarte Pt
Kalangawan
Nabung Cove
Babatngon
Caltagan I
Navahay I
Candayo Pt
Baco
Malibago
Bino-ongan
Plandel
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Tomandog (Anibongon)
Manunca
Mulbug
Pinogahan
Soholton
La Paz
Bagalibas
(Bagolibas)
Sta Cruz
Banug Pt
San Isidro
Uban Pt
Sta Elena
Buenavista
New San Agustan
Balayon
Burgos
Nouvilas
Basey
Oce
Magallanes

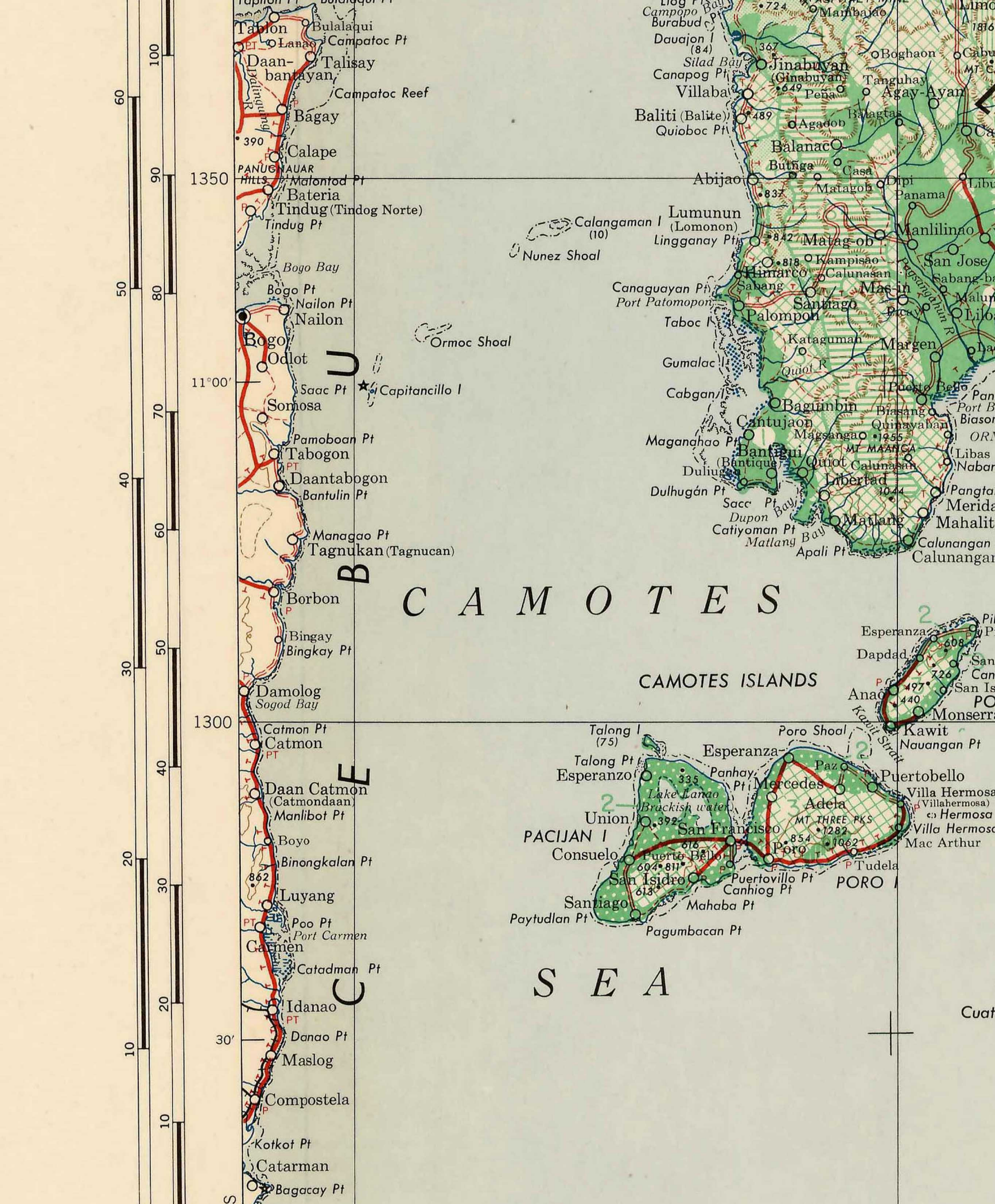
SECOND EDITION-AMS 2

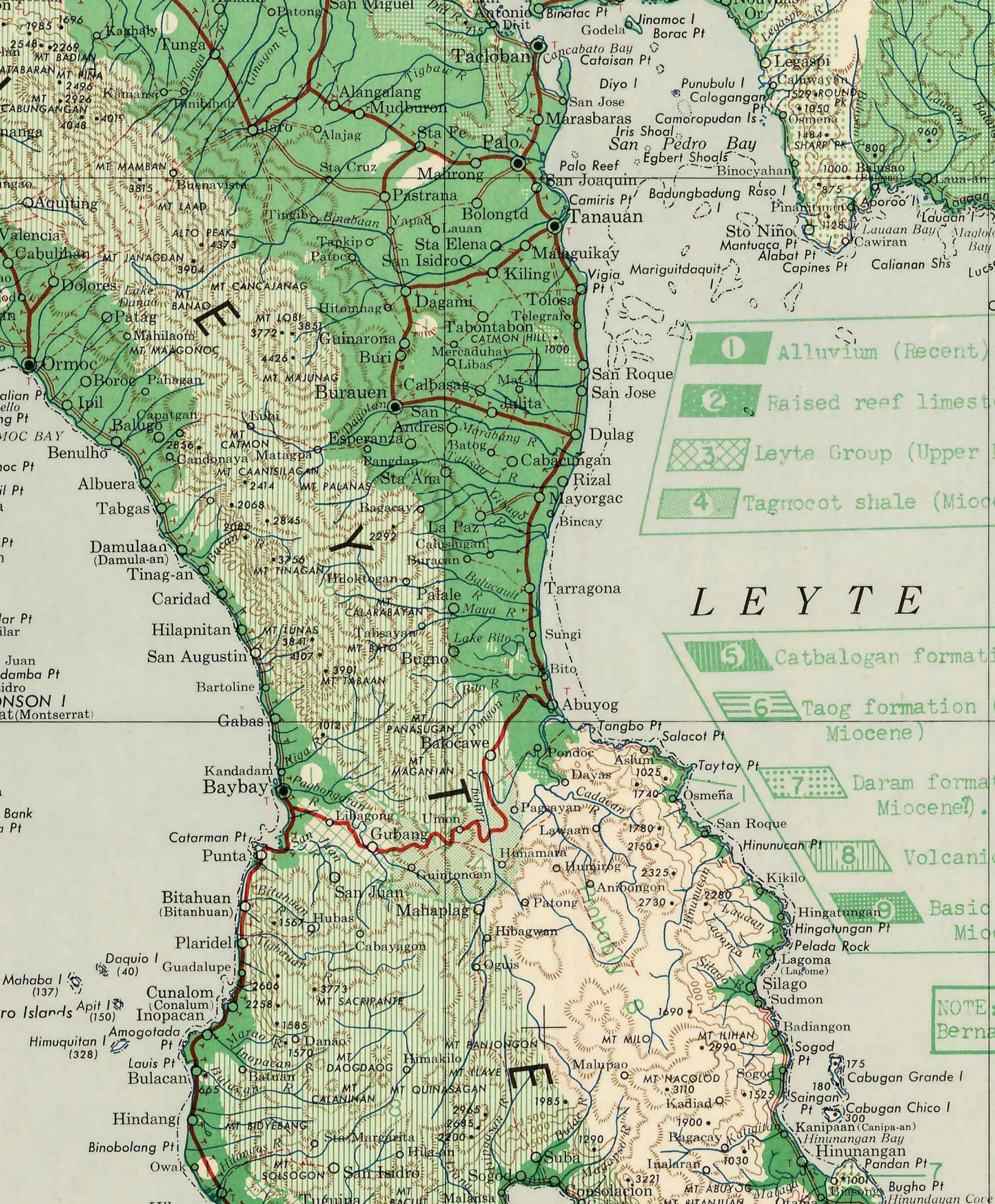
NC 51-3

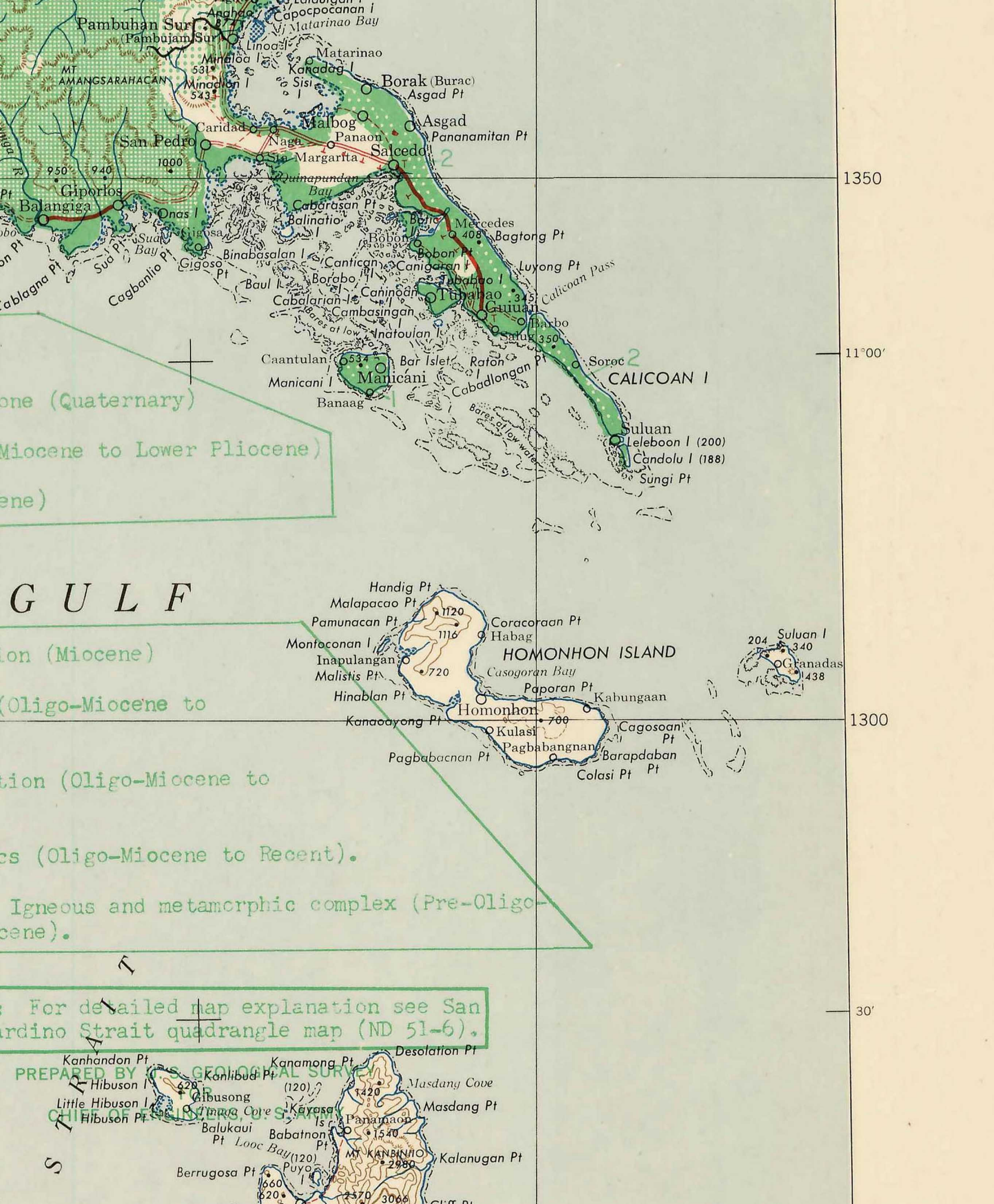
SAMAR AND LEYTE (P.I.)

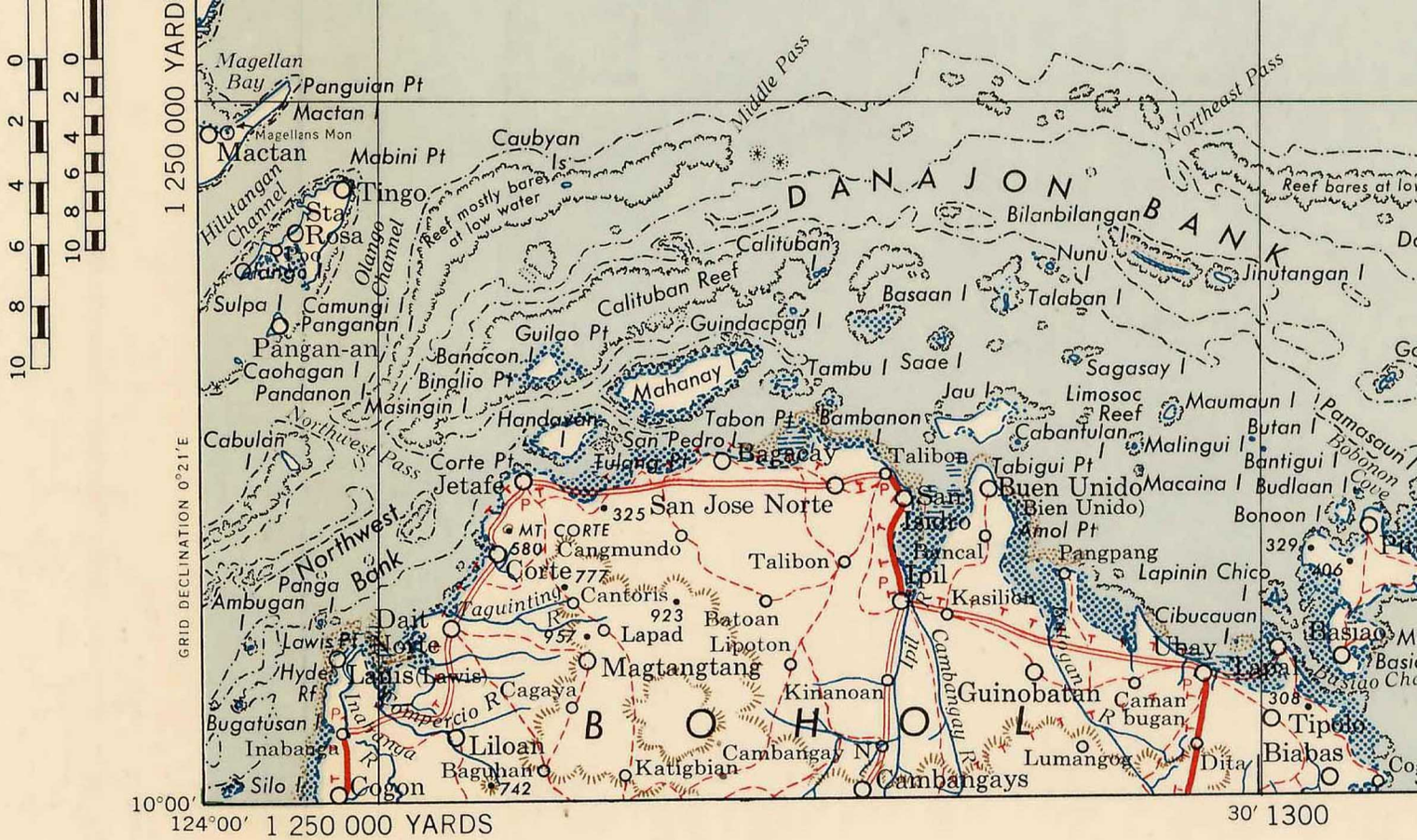
RELIABILITY: Northwest Leyte and Camotes Islands Good; remainder of area, Poor.




Tapion
Bulalaqui
Lanao
Campatoc Pt
Daan-bantayan
Talisay
Campatoc Reef
Bagay
Calape
PANUGNAUAR Hills
Malontod Pt
Bateria
Tindug (Tindog Norte)
Tindug Pt
Bogo Bay
Bogo Pt
Nailon Pt
Nailon
Bogo
Odlot
Saac Pt
Capitancillo I
Somosa
Pamoboan Pt
Tabogon
Daantabogon
Bantulin Pt
Managao Pt
Tagnukan (Tagnucan)
Borbon
Bingay
Bingkay Pt
Damolog
Sogod Bay
Catmon Pt
Catmon
Daan Catmon (Catmondaan)
Manlibot Pt
Boyo
Binongkalan Pt
Luyang
Poo Pt
Port Carmen
Carmen
Catadman Pt
Idanao
Danao Pt
Maslog
Compostela
Kotkot Pt
Catarman
Bagacay Pt
Ormoc Shoal
Calangaman I (10)
Nunez Shoal
Lumunun (Lomonon)
Lingganay Pt
Canaguayan Pt
Port Patomopon
Taboc I
Gumalac
Cabgan I
Maganahao Pt
Duliugan (Bantique)
Dulhugán Pt
Sacc Pt
Dupon Bay
Catiyoman Pt
Matlang Bay
Apali Pt
Mambajao
Burabud
Daujon I (84)
Silad Bay
Canapog Pt
Jinabuyan (Ginabuyan)
Villaba
Baliti (Balite)
Quioboc Pt
Agadob
Balanac
Butnga
Casa
Abijao
Matagob
Panama
Manlilinao
Matag-ob
Kampisao
Himarco
Calunasan
Sabang
Santiago
Palompon
Kataguman
Margen
Quiot R
Bagüinbin
Cantujaon
Quinayaban
Bantigui
Quiot
Libertad
Matlang
Mahalit
Calunangan
Esperanza
Dapdad
Anao
Monserrat
Kawit
Nauangan Pt
Kawit Strait
Poro Shoal
Talong I (75)
Talong Pt
Esperanzo
Panhay Pt
Paz
Mercedes
Puertobello
Villa Hermosa (Villahermosa)
Lake Lanao
Brackish water
Union
Adela
MT THREE PKS
San Francisco
Poro
Mac Arthur
PACIJAN I
Consuelo
Puerto Bello
Tudela
San Isidro
Puertovillo Pt
Canhiog Pt
PORO I
Santiago
Mahaba Pt
Paytudlan Pt
Pagumbacan Pt
CAMOTES ISLANDS
CAMOTES SEA
CEBU
1350
1300
11°00'
30'


LEYTE
1 Alluvium (Recent)
2 Raised reef limest
3 Leyte Group (Upper
4 Tagrocot shale (Mioc
5 Catbalogan formati
6 Taog formation (
Miocene)
7 Daram forma
Miocene?)
8 Volcani
9 Basic
Mio
NOTE:
Berna
Tacloban
Palo
Tanauan
Dulag
Abuyog
Baybay
Ormoc
Carigara
Barugo
Jaro
Alangalang
Mudburon
Marasbaras
Sta Fe
Malirong
Pastrana
Bolongtd
Sta Elena
Malaguikay
Kiling
Dagami
Tolosa
Tabontabon
Guinarona
Buri
Burauen
Calbasag
Julita
San Roque
San Jose
Esperanza
Batog
Cabacungan
Rizal
Mayorgac
Bincay
La Paz
Sta Ana
Rangdan
Matagpa
Candonaya
Benulho
Albuera
Tabgas
Damulaan
(Damula-an)
Tinag-an
Caridad
Hilapnitan
San Augustin
Bartoline
Gabas
Kandadam
Libagong
Union
Gubang
Catarman Pt
Punta
Bitahuan
(Bitanhuan)
Plaridel
Daquio I
(40)
Guadalupe
Cunalom
(Conalum)
Inopacan
Apit I
(150)
Mahaba I
(137)
Amogotada Pt
Himuquitan I
(328)
Lavis Pt
Bulacan
Hindang
Binobolang Pt
Owak
Tugunipa
Balocawe
Pagbongdran R
Higa R
Bito R
Ponson R
Tangbo Pt
Salacot Pt
Pondoc
Aslum
Taytay Pt
Dayas
Osmeña
Pagsayan
Lawaan
San Roque
Hinunucan Pt
Hinunucan R
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
(Lagome)
Silago
Sudmon
Badiangon
Sogod
Cabugan Grande I
Cabugan Chico I
Kanipaan (Canipa-an)
Hinunangan
Hinunangan Bay
Pandan Pt
Bugho Pt
Binasong
Hinundayan Cou
Consolacion
Sogod
Inalaran
Bagacay
Kadiad
Malupao
Himakilo
Hubas
Patong
Hibagwan
Cabayagon
Oguis
Guintonoan
Anibongon
Humirog
Hamamara
Lawaan
Pagsayan
Tarragona
Sungi
Bito
Palale
Hiloktogan
Buracan
Caluslugan
Talisayan
Bugno
Lake Bito
Maya R
Palale R
Ballucauit R
Julita
Mercaduha
Libas
Telegrafo
Catmon Hill
1000
Mariguitdaquit I
Vigia Pt
Capines Pt
Calianan Shs
Sto Niño
Mantuaca Pt
Alabat Pt
Cawiran
Lauaan Bay
Pinanitinan
Aporoo I
Badungbadung Raso I
Camiris Pt
San Joaquin
Binocyahan
Palo Reef
Egbert Shoals
San Pedro Bay
Iris Shoal
Camoropudan Is
Diyo I
Cancabato Bay
Cataisan Pt
Binatac Pt
Jinamoc I
Borac Pt
Godela
Legaspi
Caluwayan
Cologangan Pt
Punubulu I
Osmeña
Sharp Pk
Balusao
Laua-an
Lauaan I
Lagaan
Lauaan R
Lagoma R
Sitaad R
Hinunucan R
Cadacan R
Lubi R
Bito R
Bato R
Marabang R
Talisay R
Cabugo R
Bucan R
Dagami R
Tigbao R
Tinagon R
Tungad R
Binabaan R
Yapad R
Tingib
Tankip
Patoc
Hitomnag
Pahagan
Capatgan
Lubi
Ipil
Boroc
Patag
Mahilaom
Dolores
Aquiting
Valencia
Cabulihan
Kaghaly
Tunga
Kamansi
Hinibihan
Patong
San Miguel
Antonio
Di-it
715
Mt Badian
Mt Mina
2496
Mt 2926
Cabungangan
4048
4019
Mt Mamban
3815
Buenavista
Mt Laad
Alto Peak
4373
Mt Janagdan
3904
Lake Danao
Mt Banao
Mt Cancajanag
Mt 1081
3851
3772
Mt Maagonoc
4426
Mt Majunag
Mt Catmon
2856
Mt Caanisilagan
2414
Mt Palanas
2068
2085
2845
2292
3756
Mt Tinagan
Mt Calarabayan
Mt Iunas
3841
4107
Mt Bato
3901
Mt Tabaan
1012
Mt Panasugan
Mt Maganian
Mt Sacripante
2606
2258
1585
1570
Mt Daogdaog
Mt Quinasagan
Mt Calanuman
Mt Bidyebang
Mt Solsogon
Mt Panjongon
Mt Ilaye
Mt Milo
Mt Ilihan
2990
Mt Nacolod
3110
1985
2965
2685
2200
1290
3227
Mt Abuyog
Mt Ritanjuan
Malansa
3773
1525
1690
1740
1780
2150
2325
2730
2280
1025
1030
1000
665
1900
1484
1050
1000
960
875
800
1128
180
175
300
Sharp Pk
Round Pk
Osmeña
Lagaan I
Lauaan I
Lauaan Bay
Maglol
Bay
Lucs
Lauaan R
Babatn
Balusao
Laua-an
Lagaan


Pambuhan Sur
(Pambujam Sur)
Anahao
Capocpocanan I
Matarinao Bay
Linoa
Matarinao
MT AMANGSARAHACAN
Minaloa I
531
Minadlan I
543
Kanadag I
Sisi I
Borak (Burac)
Asgad Pt
Caridad
Malbog
Asgad
Pananamitan Pt
San Pedro
Naga
Panaon
Salcedo
Sta Margarita
950
940
1000
Quinapundan Bay
Giporlos
Balangiga
Onas I
Cabarasan Pt
Balinatio I
Bato
Mercedes
408
Bagtong Pt
Sua Pt
Sua Bay
Cigosa
Bobon
Bobon Pt
Binabasalan I
Cantican
Canigaran I
Luyong Pt
Gigoso Pt
Baul I
Borabo I
Tubabao I
Caninoan
Tubabao
345
Calicoan Pass
Cabalarian I
Cambasingan I
Guiuan
Barbo
Inatoulan I
Salug
350
Caantulan
534
Bar Islet
Raton
Soroc
Manicani I
Manicani
Cabadlongan Pt
CALICOAN I
Banaag
Bares at low water
Suluan
Leleboon I (200)
Candolu I (188)
Sungi Pt
Handig Pt
Malapacao Pt
1120
Pamunacan Pt
Coracoran Pt
1116
Habag
Montoconan I
Inapulangan
720
HOMONHON ISLAND
Malistis Pt
Casogoran Bay
Hinablan Pt
Paporan Pt
Kabungaan
Homonhon
700
Kanaoayong Pt
Kulasi
Cagosoan Pt
Pagbabangnan
Pagbabacnan Pt
Barapdaban Pt
Colasi Pt
204
Suluan I
340
Granadas
438
Kanhandon Pt
Kanlibud Pt
Desolation Pt
Kanamong Pt
Hibuson I
628
(120)
Masdang Cove
1420
Gibusong
Little Hibuson I
Timaua Cove
Kayasa Is
Masdang Pt
Hibuson Pt
Panamaon
Balukaui Pt
Looc Bay
Babatnon Pt
1540
MT KANBINIO
2980
Kalanugan Pt
(120)
Puyo I
Berrugosa Pt
660
620
2570
3066
1350
11°00'
1300
30'
STRAIT
GULF
one (Quaternary)
Miocene to Lower Pliocene)
ene)
ion (Miocene)
(Oligo-Miocene to
tion (Oligo-Miocene to
cs (Oligo-Miocene to Recent).
Igneous and metamorphic complex (Pre-Oligo-
cene).
For detailed map explanation see San
ardino Strait quadrangle map (ND 51-6).
PREPARED BY U.S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U.S. ARMY



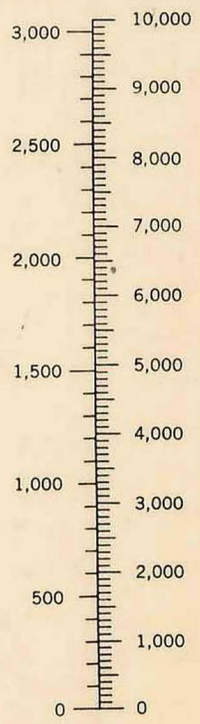
A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington

Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philipp 1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map o Samar Island, 1:63,360, O. C. E. O., Phil. Div., No. 1, 1908. Standard Recon. Map, Surigao & Augusan, 1:100,000, Inc. Co., I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobiloil Roa P. I., 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Roac Philippines, 1:500,000, Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,00 No. 100, 1933.

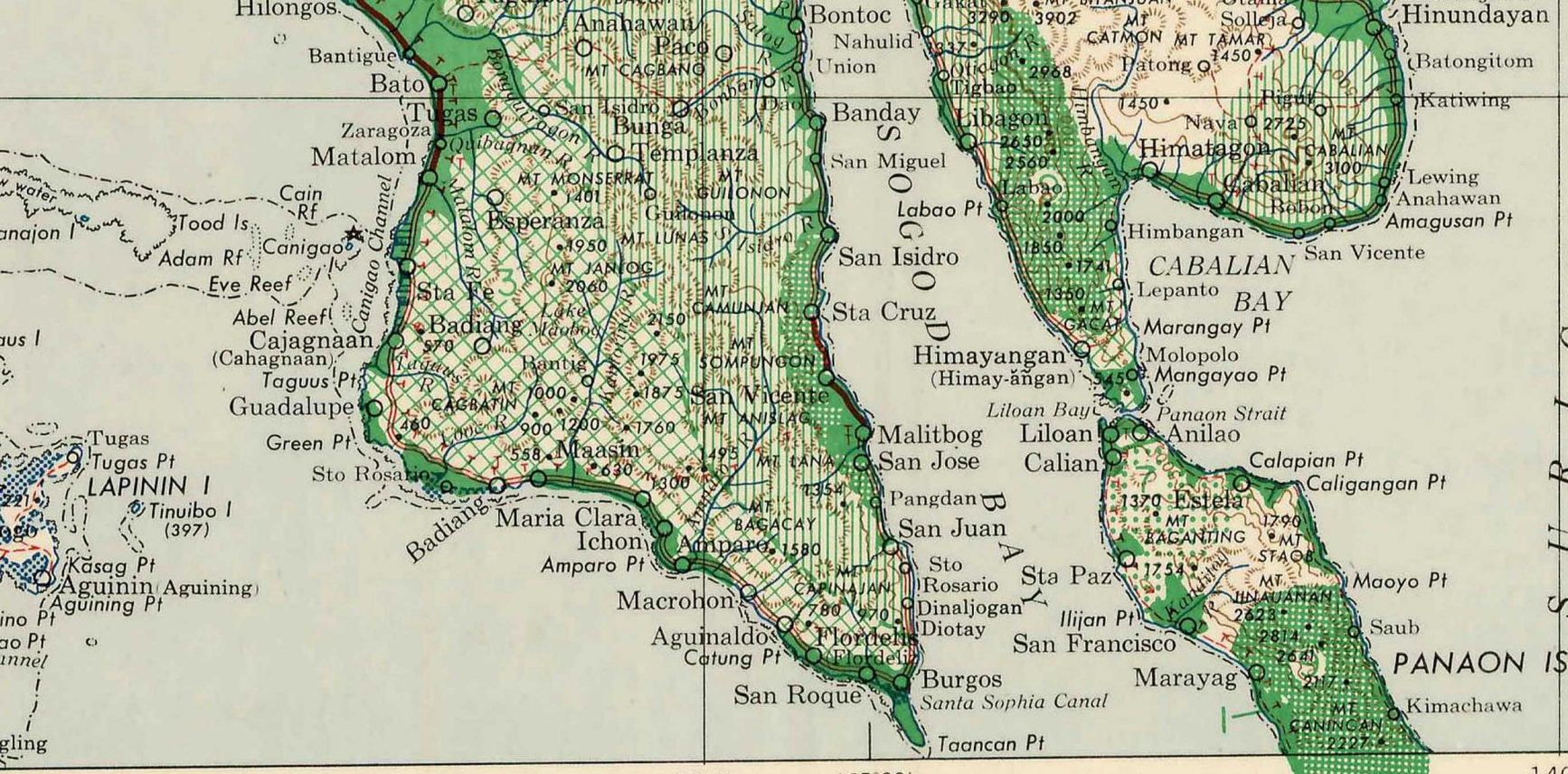
CONVERSION GRAPH
NOT at the scale of the map.



LEGEND

Road, surfaced, all-weather
Road, partially surfaced, generally all-weather
Track, Trail
Road under construction, 1941
Boundary, International Treaty Limits
Boundary, Provincial
Boundary, Chartered City
Railroad, 3'6" gauge; with Station
Railroad, Less than 3'6" gauge
Railroad, Electric — ELECTRIFIED
Telephone and Telegraph Line
Power Transmission Line

City, First Importance — MANILA
City, Second Importance — DAVAO
City or Large Town — Tagum
Small Town — Peña
Village or Settlement — Kalan
Aerodrome, Auxiliary Landing Field
Seaplane Base, Auxiliary Anchorage
Principal Navigation Light
Radio Station
Telephone Station, Telegraph Station
Mud Flat, Tidal Flat
Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

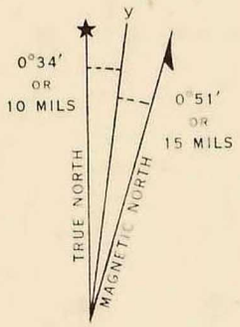
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS WASHINGTON, D. C.



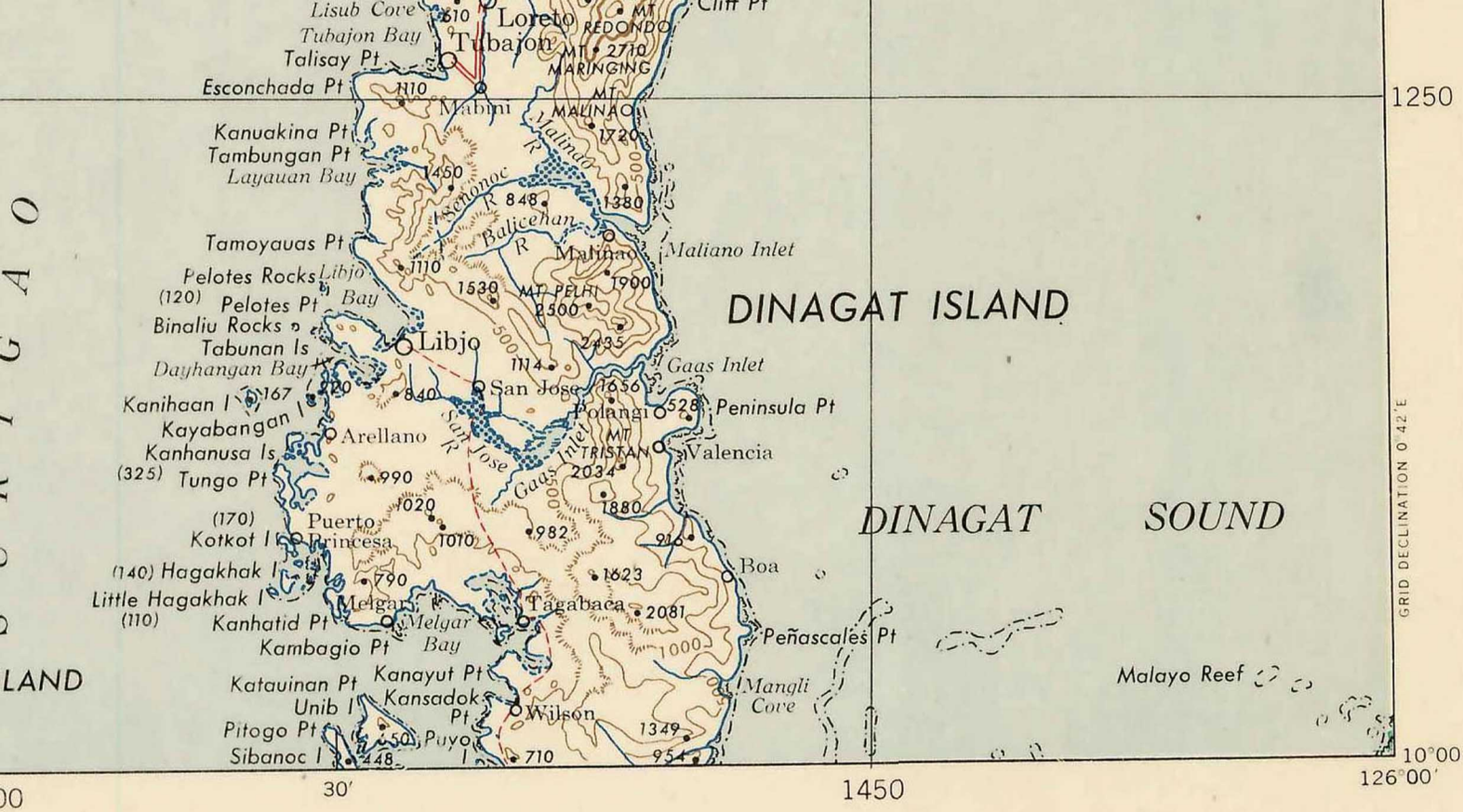
APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

, D. C., 1944.
1936; 4422,
pine Islands,
of Portion of
No. 1. Vols.
ad Map of the
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Hq. Mil. Int.,
00, USC & GS,

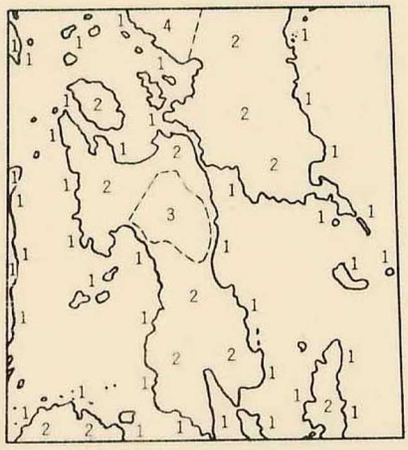
[redacted]

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

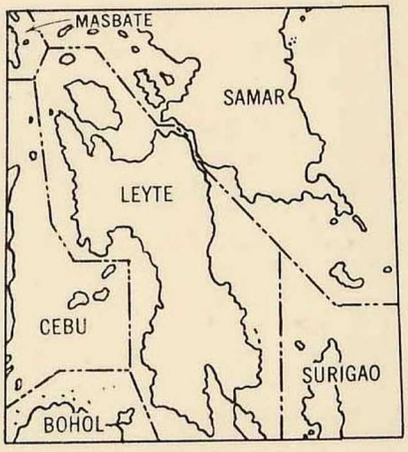


ARMY MAP SERVICE, U S ARMY, WASHINGTON D. C. 112094
9-44 1944

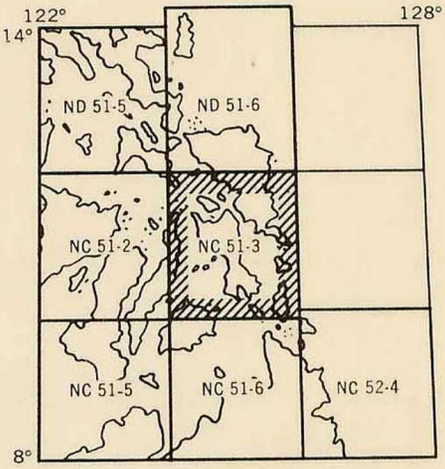
COVERAGE DIAGRAM



INDEX TO BOUNDARIES



INDEX TO ADJOINING SHEETS



1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

SAMAR AND LEYTE (P.I.)

Reliability: Camotes Islands and northwest Leyte, Good; rest of area, Poor.

INTRODUCTION

The geology of northwest Leyte and the Camotes Islands is described in considerable detail in the National Development Company Petroleum Survey report, accompanied by reconnaissance geologic maps on a scale of 1:50,000. The scanty information on the rest of Leyte and on Samar is largely contained in reconnaissance reports and maps (scale 1:775,000) of the Petroleum Survey. Older reconnaissance reports by Adams (with map of Leyte) and by Schenck (on Samar), both based on a few coastal observations and inland traverses, furnish some additional information.

The geologic maps in this report are based largely on the National Development Company reports and maps supplemented by those of Adams and Schenck.

The broad aspects of the geology of Leyte and Samar are similar. A basement of chiefly pre-Tertiary basic igneous and metamorphic rocks is exposed discontinuously in several parallel structurally high belts. The easternmost belt trends about N 20° W from the south coast of Samar, where a broad area of basement rocks is exposed. Similar rocks are exposed in north-central Samar. To the west another belt trends about N 15° W from southern Leyte through northeast Leyte to northwest Samar, marked by a number of smaller exposures of basement complex on Leyte and a large exposure on northwest Samar. A third belt, an anticlinorium gently plunging northward, trends about N 15° W through northwest Leyte and possibly through the Camotes Islands. Several very small areas of basement rocks are exposed along this trend. These major trends are continued northwest to the island of Luzon.

On Samar, a few thousand feet of Miocene marine sedimentary rocks flank the basement complex and are, in general, gently folded. On Leyte, a thick accumulation of andesitic volcanics, ranging in age from Miocene to Recent, forms the central mountain range and the Biliran and Maripipi Islands to the north. Thick, folded Miocene and Pliocene marine sedimentary rocks are exposed west of the volcanics. Most of the sedimentary rocks in this region are characterized by poor sorting and extreme variation in thickness and lithology within short distances.

Uplifted coral reefs of Quaternary age fringe parts of the islands, particularly southeast Samar, northwest Leyte, and the Camotes Islands. On Leyte, a wide alluvial plain separates the central volcanic mountain range from the smaller mountains at the northeast tip of the island. To the west, similar but smaller alluvial plains nearly separate the Tertiary sedimentary rocks of northwest Leyte from the volcanic range. Narrow, discontinuous deposits of alluvium occur along a large part of the coastline of the islands; on Samar, they extend up the major river valleys.

Leyte, the Daram Islands, and the Camotes Islands have been tectonically mobile throughout the Tertiary—at least from Lower Miocene—to the present. Numerous unconformities occur in the sedimentary formations. Volcanic activity has been intermittent during this entire period. It is probable that faulting has influenced the broad structure of these islands. Samar Island has been relatively stable during this period; in general, the Miocene unconformities are less pronounced and folding is gentle. There has been no known volcanic activity since lower Miocene. Upraised coral reefs of Pliestocene to Recent age are evidences of recent instability.

	GEOLOGY			ENGINEERING ASPECTS			
Map Unit	Rock Types	Structure	Topographic Expression	Construction Materials	Workability and Excavation Problems	Subgrades and Foundations	Surface Drainage and Permeability
1 ALLUVIUM (RECENT)	Unconsolidated gravel, sand, silt, and clay. On coastal strips, some raised coral-reef limestone, as well as more recent coral sand and poorly to well-consolidated coral deposits (for description see Map Unit 2). Alluvium is coarser grained near mountains than on lower plains. Gravel probably limited to stream and river beds and to narrow beaches along rugged parts of coast. Well-sorted, well-drained beach sand, in a strip as much as one half mile wide, common where alluvium borders coast. Along the eastern coast of Leyte and Samar coral sand predominates; elsewhere the beach is predominantly feldspathic quartz sand. Inland, alluvium is mostly silt and clay. Maximum depth probably several hundred feet on northeast plain of Leyte.	Beds lenticular, nearly flat-lying, except on piedmont fans where bedding parallels the gently sloping constructional surface.	Generally lowlands; coastal plains, beaches, and stream flood plains; lower benchlands; piedmont fans. Piedmont fans along flanks of central range in northern Leyte in places extend up to altitudes of more than 1,000 feet. Piedmont fans have slopes up to 10%, and are deeply ravined in the steeper, upper portions. Coastal strips commonly include sandy ridges as much as 20 feet high; adjoining lowland areas, underlain by silt or clay, only slightly above sea level.	Alluvial gravel and sand probably best source for concrete aggregate, base course, and surface course material. Fairly abundant in most parts of Leyte, but scarce in many parts of Samar. Alluvial silt or silty clay best natrual source for binder. Some boulders and hard coral limestone may be suitable for riprap and masonry.	Mostly unconsolidated; easily excavated with hand tools, draglines, and dozers. Walls of excavations generally require support. Permeable (andesitic) alluvium of sloping plains on both flanks of central range on northern Leyte is probably deeply weathered to clay.	Well-graded and well-compacted, sound gravel and gravel-sand mixtures are excellent subgrade materials; stable foundation material unless highly stressed. The trap-rock gravel of sloping plains on Leyte is probably deeply weathered to clay on interstream areas; will not make good subgrade. If not worked when wet, silt and clay may be usable subgrade materials.	Drainage very good on sloping alluvial areas of gravel or sand; good to fair on much of lowland area; poor on very low silty or clayey areas immediately behind well-drained sandy beach strips. Water table usually shallow on lowlands, 10 to 40 feet below surface. On sloping plains, water table may be 20 to 200 feet below surface of interstream areas, and generally a few feet, rarely more than 30 feet on flood plains. Locally, where relatively impervious silt or clay beds underlie permeable beds, water may be held far above the general water table.
2 RAISED CORAL-REEF LIMESTONE (QUATERNARY)	Coral-reef limestone, some interbedded sand, gravel, and calcareous clay; chiefly composed of coral remains. Generally hard but porous and cellular. Exposed surface may be harder than underlying rock; weathering produces a case-hardening effect. Locally compact and crystalline; friable in places, with large pieces of coral in matrix of coral sand and gravel. Beds irregular but usually only a few feet thick, locally interbedded with calcareous clay. Raised reefs around the Camotes islands are poorly bedded and poorly consolidated. Coral-reef limestone lies unconformably on older rocks.	On northwest Leyte the beds are flat-lying. On the Camotes Islands, beds probably dip seaward at angles of 1 or 2 degrees On the southeast end of Samar, beds dip gently eastward.	On Leyte, low benches at several points along the northwest coast, especially at San Isidro Bay and Arevalo Bay, are cavernous and blocky with low irregular sea cliffs. Broad alluvial area from Canaguayan Point to Sacay Point is probably underlain by a raised coral reef. Camotes Islands are completely girdled by wide, low, coral benches with coastal bluffs commonly 20 feet, rarely 50 feet, high cut in poorly consolidated coral debris. Coral limestone forms a prominent ridge on the peninsula of SE Samar, and is present on several small islands off the north, east and southeast coasts. Reef limestone also may be present elsewhere along coasts but not differentiated on map; partly included in Unit 1.	Harder varieties are excellent source for concrete aggregate, base course and surface course material, road metal, and riprap. Exposed surface often harder than interior, owing to case-hardening produced by weathering.	Generally requires drilling and blasting. Softer or less consolidated varieties may be worked with pick and bar, or by combination of bulldozer and blasting. Walls of temporary excavations commonly do not require support. Soil cover only a few feet thick.	Loading capacity moderate to high in hard varieties unless very porous or cavernous. Calcareous clays, which are sometimes interbedded with coral, have low bearing strength.	Coral-reef limestone is commonly very permeable, well drained. Local beds of calcareous clay are impervious.
3 LEYTE GROUP (UPPER MIOCENE AND LOWER PLIOCENE)	Calcareous shale, coral limestone, shale (locally bentonitic), and minor sandstone; thickness and lithology change along strike. On northwest Leyte, where group is best known, maximum thickness is about 5,000 feet. Three main divisions separated by unconformities. Uppermost division consists of poorly bedded to massive, porous coral limestone interbedded with sandstone and shale; average thickness about 160 feet. Middle division is light-colored bentonitic shale, maximum thickness about 4,300 feet; also includes an 800-foot zone of coarse, arkosic, thin-bedded and in places cross-bedded sandstone, thin-bedded limestone, and dark gray sandy shale; base of this zone is 750 feet above the base of the bentonitic shale. Sandy lenses (locally impregnated with tar) as much as 300 feet long and 50 feet thick, occur near base of upper bentonitic shale zone. Lower division is porous, white coral limestone, in places grading to calcareous shale; variable thickness, maximum about 500 feet; this is only thick massive limestone on Leyte. On the Camotes Islands, beds of same age have similar thickness, but about 40% of section is limestone. Leyte Group is unconformable on older rocks.	Beds generally gently folded; dips commonly 15° to 30°, rarely more than 50°. Coral limestone commonly jointed and fractured.	In general form moderately rugged hills. Northwest Leyte: The uppermost division; coral limestone, sandstone and shale, forms rounded hills with a prominent scarp at the contact with underlying bentonitic shale. Bentonitic shale forms grass-covered rolling hills, with numerous landslides, especially on steep slopes. Streams in small narrow gullies. Zone of sandstone, limestone, and shale forms rugged hills. Basal coral limestone forms very prominent high and rugged ridges with dense primary forest, but with numerous craggy, cavernous rock outcrops.	Hard coral limestone on northwest Leyte, on Camotes Islands, and probably elsewhere, is excellent for concrete aggregate, road metal, base course and surface course, and riprap. Tar-saturated sand lenses (see Rock Types) are source of bituminous surfacing material. Other rock types not satisfactory for construction materials.	Limestone requires drilling and blasting. Shale and calcareous shale workable with hand tools, scrapers, and dozers. Locally, sandstone may require drilling and blasting. Except in limestone and hard sandstone, deep excavations will need support, especially where inclined shale beds are encountered. Weathered zone fairly thin.	Bearing strength of limestone moderate to high; sandstone moderate; calcareous shale and bentonitic shale, low. Bentonitic shale is unstable, swells when wet; landslides common.	Limestone very well drained, commonly moderately to highly permeable; sandstone moderately well drained, moderately permeable to impermeable; shale poorly drained and impermeable.
4 TAGNOCOT SHALE (MIOCENE)	In northwest Leyte, firm, poorly bedded dark gray or blue sandy shale, with occasional lenses of coarse sandstone, rarely thicker than 10 feet, locally oil-saturated. Maximum thickness about 5,000 feet. Lies unconformably on Taog formation. In central Leyte, sandstone and shale of unknown thickness.	Moderately folded; dips typically less than 45°.	Northwest Leyte: Rolling hills; generally cultivated. Central Leyte: Moderately rugged hills.	Mostly unsuitable for construction. Oil-saturated sandstone, which occurs in small lenses, can be crushed for surfacing or bonding material.	Workable by hand tools, scrapers, and dozers. Deep excavations will probably need support.	Low to moderate bearing strength.	Fairly well drained. Impermeable except for local small, moderately permeable sand lenses. Ground water commonly saline; may taste of petroleum.
5 CATBALOGAN SANDSTONE AND CALCAREOUS SHALE (MIOCENE)	Gray to bluish gray calcareous shale (marl), commonly interbedded with much sandy shale, siltstone, and some hard calcareous sandstone. At Catbalogan, thin-bedded, fairly hard, fine-grained gray-blue feldspathic sandstone with calcareous cement, interbedded with sandy shale. Locally, as west of Taft, (east coast of Samar) soft fine-grained feldspathic sandstone. Near Catarman on north coast of Samar, mainly sandy shale; some pebble conglomerate. Thickness probably less than 2,000 feet. Beds in part of the same age (Miocene) as Tagnocot shale; uncomformable on older rocks. At least locally on Samar (as at Loquilocan), it shows little or no angular discordance with Daram formation. On Samar, part of the areas mapped as this unit may include younger or older rocks.	Beds typically very gently folded; mostly less than 20°. Probably considerable faulting, mostly small displacements, in some districts.	On Samar, typically forms rugged hills and low mountains with local relief of a hundred to a few hundred feet. Many steep slopes and narrow ridge tops; few cliffs. Although altitudes are not as great as in the Daram formation, the topography is only slightly less rugged.	Little suitable hard rock. At a few localities, conglomerate will make fair concrete aggregate or road metal.	Most of formation can be worked with hand tools and dozers. Some beds of conglomerate and hard sandstone will require drilling and blasting. Deep temporary excavations commonly will require some support, especially where rocks are strongly fractured.	Moderate to low bearing strength.	Moderately well drained. Generally impermeable; locally conglomerate and coarser sandstone beds may be slightly permeable.

(continued)

SAMAR AND LEYTE (P.I.)

The geology of northwest Leyte and the Camotes Islands is described in considerable detail in the National Development Company Petroleum Survey report, accompanied by reconnaissance geologic maps on a scale of 1:50,000. The scanty information on the rest of Leyte and on Samar is largely contained in reconnaissance reports and maps (scale 1:775,000) of the Petroleum Survey. Older reconnaissance reports by Adams (with map of Leyte) and by Schenck (on Samar), both based on a few coastal observations and inland traverses, furnish some additional information.

The geologic maps in this report are based largely on the National Development Company reports and maps supplemented by those of Adams and Schenck.

The broad aspects of the geology of Leyte and Samar are similar. A basement of chiefly pre-Tertiary basic igneous and metamorphic rocks is exposed discontinuously in several pa
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	GEOLOGY	
Map Unit	Rock Types	St
1 ALLUVIUM (RECENT)	Unconsolidated gravel, sand, silt, and clay. On coastal strips, some raised coral-reef limestone, as well as more recent coral sand and poorly to well-consolidated coral deposits (for description see Map Unit 2). Alluvium is coarser grained near mountains than on lower	Beds nearl ing, piedm where paral

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Reliability: Camotes Islands and northwest Leyte, Good; rest of area, Poor.

INTRODUCTION

arallel structurally high belts. The eastern-
ends about N 20° W from the south coast of
a broad area of basement rocks is exposed.
s are exposed in north-central Samar. To the
belt trends about N 15° W from southern Leyte
heast Leyte to northwest Samar, marked by a
aller exposures of basement complex on Leyte
exposure on northwest Samar. A third belt,
rium gently plunging northward, trends about
ugh northwest Leyte and possibly through the
nds. Several very small areas of basement
posed along this trend. These major trends
d northwest to the island of Luzon.

r, a few thousand feet of Miocene marine sedi-
s flank the basement complex and are, in gen-
folded. On Leyte, a thick accumulation of
lcanics, ranging in age from Miocene to Recent,
ntral mountain range and the Biliran and
Maripipi Islands to the north. Thick, f
Pliocene marine sedimentary rocks are ex
volcanics. Most of the sedimentary rock
are characterized by poor sorting and ex
in thickness and lithology within short

Uplifted coral reefs of Quaternary
of the islands, particularly southeast S
Leyte, and the Camotes Islands. On Leyt
plain separates the central volcanic mou
the smaller mountains at the northeast t
To the west, similar but smaller alluvia
separate the Tertiary sedimentary rocks
from the volcanic range. Narrow, discon
of alluvium occur along a large part of
of the islands; on Samar, they extend up
valleys.

Leyte, the Daram Islands, and the C

ructure	Topographic Expression	Construction Materials	Workabi Excavatio
lenticular, y flat-ly- except on ont fans bedding lels the	Generally lowlands; coastal plains, beaches, and stream flood plains; lower benchlands; piedmont fans. Piedmont fans along flanks of central range in northern Leyte in places extend up to altitudes	Alluvial gravel and sand probably best source for concrete aggregate, base course, and surface course material. Fairly a-	Mostly unconsol vated with hand and dozers. Wa generally requi eable (andesiti sloping plains

GEOLOGY

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tinuous deposits
the coastline
the major river

have been tectonically mobile throughout the Tertiary—at least from Lower Miocene—to the present. Numerous unconformities occur in the sedimentary formations. Volcanic activity has been intermittent during this entire period. It is probable that faulting has influenced the broad structure of these islands. Samar Island has been relatively stable during this period; in general, the Miocene unconformities are less pronounced and folding is gentle. There has been no known volcanic activity since lower Miocene. Upraised coral reefs of Pliestocene to Recent age are evidences of recent instability.

amotes Islands

ENGINEERING ASPECTS

lity and n Problems	Subgrades and Foundations	Surface Drainage and Permeability
idated; easily excatools, draglines, lls of excavations re support. Permc) alluvium of on both flanks of	Well-graded and well-compacted, sound gravel and gravel-sand mixtures are excellent subgrade materials; stable foundation	Drainage very good on sloping alluvial areas of gravel or sand; good to fair on much of lowland area; poor on very low silty or clayey areas immediately behind well-drained sandy

	plains. Gravel probably limited to stream and river beds and to narrow beaches along rugged parts of coast. Well-sorted, well-drained beach sand, in a strip as much as one half mile wide, common where alluvium borders coast. Along the eastern coast of Leyte and Samar coral sand predominates; elsewhere the beach is predominantly feldspathic quartz sand. Inland, alluvium is mostly silt and clay. Maximum depth probably several hundred feet on northeast plain of Leyte.	gentl const surfa
2 RAISED CORAL-REEF LIMESTONE (QUATERNARY)	Coral-reef limestone, some interbedded sand, gravel, and calcareous clay; chiefly composed of coral remains. Generally hard but porous and cellular. Exposed surface may be harder than underlying rock; weathering produces a case-hardening effect. Locally compact and crystalline; friable in places, with large pieces of coral in matrix of coral sand and gravel. Beds irregular but usually only a few feet thick, locally interbedded with calcareous clay. Raised reefs around the Camotes islands are poorly bedded and poorly consolidated. Coral-reef limestone lies unconformably on older rocks.	On no Leyte are f On the Island probal seawa of 1 On the east Samar gentl
3 LEYTE GROUP (UPPER MIOCENE AND LOWER PLIOCENE)	Calcareous shale, coral limestone, shale (locally bentonitic), and minor sandstone; thickness and lithology change along strike. On northwest Leyte, where group is best known, maximum thickness is about 5,000 feet. Three main divisions separated by unconformities. Uppermost division consists of poorly bedded to massive, porous coral limestone interbedded with sandstone and shale; average thickness about 160 feet. Middle division is light-colored bentonitic shale, maximum thickness about 4,300 feet; also includes an 800-foot zone of coarse, arkosic, thin-bedded and in places cross-bedded sandstone, thin-bedded limestone, and dark gray sandy shale; base of this zone is 750 feet above the base of the bentonitic shale. Sandy lenses(locally impregnated with tar) as much as 300 feet long and 50 feet thick, occur near base of upper bentonitic shale zone. Lower division is porous, white coral limestone, in places grading to calcareous shale; variable thick-	Beds gentl dips 15° t rarel 50°. limes monly and f

y sloping ructional ce.	of more than 1,000 feet. Piedmont fans have slopes up to 10%, and are deeply ravined in the steeper, upper portions. Coastal strips commonly include sandy ridges as much as 20 feet high; adjoining lowland areas, underlain by silt or clay, only slightly above sea level.	bundant in most parts of Leyte, but scarce in many parts of Samar. Alluvial silt or silty clay best natrual source for binder. Some boulders and hard coral limestone may be suitable for riprap and masonry.	central range o is probably dee clay.
rthwest the beds lat-lying. e Camotes ds, beds bly dip rd at angles or 2 degrees e south- end of , beds dip y eastward.	On Leyte, low benches at several points along the northwest coast, especially at San Isidro Bay and Arevalo Bay, are cavernous and blocky with low irregular sea cliffs. Broad alluvial area from Canaguayan Point to Sacay Point is probably underlain by a raised coral reef. Camotes Islands are completely girdled by wide, low, coral benches with coastal bluffs commonly 20 feet, rarely 50 feet, high cut in poorly consolidated coral debris. Coral limestone forms a prominent ridge on the peninsula of SE Samar, and is present on several small islands off the north, east and southeast coasts. Reef limestone also may be present elsewhere along coasts but not differentiated on map; partly included in Unit 1.	Harder varieties are excellent source for concrete aggregate, base course and surface course material, road metal, and riprap. Exposed surface often harder than interior, owing to case-hardening produced by weathering.	Generally requi blasting. Soft solidated varie with pick and b nation of bulld Walls of tempor commonly do not Soil cover only
generally y folded; commonly o 30°, y more than Coral tone com- jointed ractured.	In general form moderately rugged hills. Northwest Leyte: The uppermost division; coral limestone, sandstone and shale, forms rounded hills with a prominent scarp at the contact with underlying bentonitic shale. Bentonitic shale forms grass-covered rolling hills, with numerous landslides, especially on steep slopes. Streams in small narrow gullies. Zone of sandstone, limestone, and shale forms rugged hills. Basal coral limestone forms very prominent high and rugged ridges with dense primary forest, but with numerous craggy, cavernous rock outcrops.	Hard coral limestone on northwest Leyte, on Camotes Islands, and probably elsewhere, is excellent for concrete aggregate, road metal, base course and surface course, and riprap. Tar-saturated sand lenses (see Rock Types) are source of bituminous surfacing material. Other rock types not satisfactory for construction materials.	Limestone requi blasting. Shal shale workable scrapers, and d sandstone may r and blasting. stone and hard excavations wil especially wher beds are encoun zone fairly thi

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res drilling and er or less con-ties may be worked ar, or by combi-ozer and blasting. ary excavations require support. a few feet thick.	Loading capacity moderate to high in hard varieties unless very porous or caver-nous. Calcareous clays, which are sometimes interbedded with coral, have low bearing strength.	Coral-reef limestone is commonly very permeable, well drained. Local beds of calcareous clay are impervious.
res drilling and e and calcareous with hand tools, ozers. Locally, equire drilling Except in lime-sandstone, deep l need support, e inclined shale tered. Weathered n.	Bearing strength of limestone moderate to high; sandstone mod-erate; calcareous shale and bentonitic shale, low. Bentoni-tic shale is unstable, swells when wet; land-slides common.	Limestone very well drained, commonly moderately to highly permeable; sandstone moderately well drained, moderately perme-able to impereable; shale poorly drained and impermeable.

	ness, maximum about 500 feet; this is only thick massive limestone on Leyte. On the Camotes Islands, beds of same age have similar thickness, but about 40% of section is limestone. Leyte Group is unconformable on older rocks.	
4 TAGNOCOT SHALE (MIOCENE)	In northwest Leyte, firm, poorly bedded dark gray or blue sandy shale, with occasional lenses of coarse sandstone, rarely thicker than 10 feet, locally oil-saturated. Maximum thickness about 5,000 feet. Lies unconformably on Taog formation. In central Leyte, sandstone and shale of unknown thickness.	Modera ed; di cally 45°.
5 CATBALOGAN SANDSTONE AND CALCAREOUS SHALE (MIOCENE)	Gray to bluish gray calcareous shale (marl), commonly interbedded with much sandy shale, siltstone, and some hard calcareous sandstone. At Catbalogan, thin-bedded, fairly hard, fine-grained gray-blue feldspathic sandstone with calcareous cement, interbedded with sandy shale. Locally, as west of Taft, (east coast of Samar) soft fine-grained feldspathic sandstone. Near Catarman on north coast of Samar , mainly sandy shale; some pebble conglomerate. Thickness probably less than 2,000 feet. Beds in part of the same age (Miocene) as Tagnocot shale; uncomformable on older rocks. At least locally on Samar (as at Loquilocan), it shows little or no angular discordance with Daram formation. On Samar, part of the areas mapped as this unit may include younger or older rocks.	Beds t very g folded less t Probab sidera ing, m displa in som ricts.

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typically gently d; mostly than 20°. ly con- able fault- ostly small acements, he dis-	On Samar, typically forms rugged hills and low mountains with local relief of a hundred to a few hundred feet. Many steep slopes and narrow ridge tops; few cliffs. Although altitudes are not as great as in the Daram formation, the topography is only slightly less rugged.	Little suitable hard rock. At a few localities, conglomerate will make fair concrete aggregate or road metal.	Most of formatio with hand tools beds of conglome sandstone will and blasting. I excavations comm some support, es rocks are strong

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d tools, scrapers, ep excavations will upport.	Low to moderate bearing strength.	Fairly well drained. Impermeable except for local small, moderately permeable sand lenses. Ground water commonly saline; may taste of petroleum.
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(continued)

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SAMAR AND LEYTE(P.I.)

Reliability: Camotes Islands and northwest Leyte, Good; rest of area, Poor.

GEOLOGY				ENGINEERING ASPECTS			
Map Unit	Rock Types	Structure	Topographic Expression	Construction Materials	Workability and Excavation Problems	Subgrades and Foundations	Surface Drainage and Permeability
6 TAOG FORMATION (OLIGO-MIOCENE TO MIOCENE)	Recognized only on northwest Leyte. Well-bedded, brown sandstone and sandy shale; small masses of conglomerate; some black carbonaceous shale with coal stringers. Well rounded fragments of basic igneous rocks make up most of sandstone and conglomerate. Maximum thickness about 8,000 feet; lower 2,500 feet mainly coarse sandstone and conglomerate. Unconformable on basic igneous rocks of Unit 8.	Upper 5,300 feet is moderately folded with most dips between 30° and 45°. Lower part, probably separated from the upper by an angular unconformity, is much contorted and distrubed, with many steep dips, much fracturing and shattering.	Rolling to moderately rugged topography, generally forest covered, rarely cultivated.	Similar to Unit 5.	Similar to Unit 5.	Similar to Unit 5.	Similar to Unit 5.
7 DARAM FORMATION (OLIGO-MIOCENE TO MIOCENE (?))	Hard, gray, fine-to coarse-grained, tuffaceous sandstone; hard, compact, coarse-grained graywacke; generally poorly sorted and lime-cemented. Associated fine to coarse-grained limestone conglomerate. Hard, black shale. Hard, compact, yellowish-white to gray-white orbitoidal limestone, thin-bedded to thick-bedded and massive. Interbedded with soft to hard white calcareous shale (marl). Locally interbedded flows and intrusives of andesitic rocks. Thickness of formation obscured by intense deformation; probably several thousand feet. Unconformable on basic igneous and metamorphic complex and may be at least partly equivalent in age to the lower part of the Taog formation on northwest Leyte.	Beds commonly strongly folded and faulted. At least the upper part of the Daram formation on Samar, however, is only gently folded. Steep dips in places; zones of closely spaced shattering and fracturing are common. Locally sheared and crushed.	Moderately rugged to very rugged hills and mountains with very steep slopes, and sharp, in places knife-edged ridges. Outcrops may be extensive on steep slopes; most numerous along streams. Limestones form prominent ridges and escarpments, very rugged and craggy, with many caves, especially north of Schoton, and at Matuguinao in northern Samar. The Catubig River runs underground for about 3 miles in a limestone cavern area, from a point about 9 miles northeast of Matuguinao.	Hard massive limestones are excellent source for concrete aggregate, road metal, base course and surface course, and riprap. Some hard calcareous sandstone and conglomerate is a fair source of concrete aggregate and base course.	Most rock requires drilling and blasting. Temporary excavation usually will not require support except in strongly shattered zones.	Bearing strength moderate to high.	Well drained. Generally impermeable except for cavernous areas in limestone; underground drainage extensive through solution channels.
8 VOLCANICS (OLIGO-MIOCENE TO RECENT)	Andesitic flows, cones, intrusives, tuff, and agglomerate. The flows and intrusives, dense and hard when fresh, are gray, fine- to medium-grained andesites. Locally the intrusives are porphyritic. No detailed information on the pyroclastics, but probably not as resistant to weathering as flows or intrusives. Volcanic rocks locally bleached and altered to a light-colored clay by continuing solfataric action, especially on high ridge about seven miles south-southwest of Burauen, on Leyte, and at various localities on Biliran Island. Sulphur locally present.	Flows and most intrusives are commonly closely fractured. Young flows probably less fractured. Flows and pyroclastics may be nearly flat-lying or may have initial dips as great as 35°. Locally, folding may have imparted steeper dips.	Much of rugged central mountain range (maximum elevation 4,400 feet) reported to consist of volcanic cones. Many of them are probably not greatly modified by erosion. Young cones are very steep (35°) symmetrical, and smooth in major outline. Older eroded cones are only roughly conical, with very steep, deeply dissected slopes.	Massive, hard andesite is an excellent source of concrete aggregate, road metal, base course and surface course material, and riprap.	Weathered rocks. Rocks deeply weathered to reddish, granular, well-drained, clay soil which is easily excavated with hand tools, scrapers, or dozers. Walls of temporary excavations will stand without much support. Fresh rocks. Flows and intrusives and many agglomerates must be drilled and blasted, especially where fracturing and jointing is widely spaced. Probably some tuff can be worked with hand tools, scrapers and dozers. Walls of temporary excavations will not require support except where rock is greatly shattered or where soft beds dip toward the excavation. Volcanics altered by solfataric action can be easily excavated, but require much support.	Bearing capacity of weathered rocks low. Fresh flows and intrusives have high bearing strength; tuffs and agglomerates, low to moderate.	Generally well drained, both in weathered and fresh condition. Generally impermeable; probably some of the more recent volcanics are permeable.
9 BASIC IGNEOUS AND METAMORPHIC COMPLEX (LARGELY PRE-TERTIARY)	Basalt, gabbro, peridotite, serpentine, argillite, schist, gneiss, quartz monzonite and diorite. Relative abundance of the various rock types is not well known; in general the basic igneous rocks probably predominate over the metamorphic rocks; the more acidic igneous rocks are rare. Intruded by andesites of different type from those of Unit 8. Isolated hills between Palo and San Roque, on northeast coast of Leyte, are underlain by hard, slickensided argillite; quartzose chlorite schist; and soft, green, sheared and slickensided serpentine. Diorite and peridotite reported from near Malitbog on Leyte. On northwest Leyte and on the Camotes Islands the complex is dominantly basalt and peridotite. Nearly all the rock types present near Pambuhan Sur, on Samar.	Closely fractured, strongly shattered; serpentine and argillite intensely sheared.	Rugged, steep mountains with sharp ridges. Landslides common, especially in areas underlain by serpentine or argillite.	Fresh andesite similar to that of Unit 8. Fresh gabbro and diorite similar to andesite; may be superior. Locally may be suitable for heavy masonry. Argillite, schist, and peridotite generally suitable only for light construction. Serpentine unsuitable.	All rocks deeply weathered. Weathered rock similar to trap rocks of Unit 8. Slightly weathered or fresh rocks require drilling and blasting. Much rock is shattered or sheared, and will require support when excavated. Serpentine, much sheared, slides easily.	Weathered rocks have low bearing strength; fresh diorite and gabbro, very high; peridotite, argillite, and schist, moderate; serpentine, low, or very low if sheared.	Weathered and fresh rocks generally well drained. Rocks generally impermeable, except along parts of fractured zones.

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army

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SAMAR AND LEYTE (P.I.)

Map Unit	Rock Types	GEOLO
6 TAOG FORMATION (OLIGO-MIOCENE	Recognized only on northwest Leyte. Well-bedded, brown sandstone and sandy shale; small masses of conglomerate; some black carbonaceous shale with coal stringers.	Upp fee ate wit

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Reliability: Camotes Islands and northwest Leyte, Good; rest of area, Poor.

OGY			
Structure	Topographic Expression	Construction Materials	Worka Excavat
er 5,300 t is moder- ly folded h most dips	Rolling to moderately rugged to- pography, generally forest cover- ed, rarely cultivated.	Similar to Unit 5.	Similar to Uni

ENGINEERING ASPECTS		
ability and tion Problems	Subgrades and Foundations	Surface Drainage and Permeability
t 5.	Similar to Unit 5.	Similar to Unit 5.

TO MIOCENE)	Well rounded fragments of basic igneous rocks make up most of sandstone and conglomerate. Maximum thickness about 8,000 feet; lower 2,500 feet mainly coarse sandstone and conglomerate. Unconformable on basic igneous rocks of Unit 8.	bet 450 pro rat upp ang for muc and wit dip fra sha
7 DARAM FORMATION (OLIGO-MIOCENE TO MIOCENE (?))	Hard,,gray, fine-to coarse-grained, tuffaceous sandstone; hard, compact, coarse-grained graywacke; generally poorly sorted and lime-cemented. Associated fine to coarse-grained limestone conglomerate. Hard, black shale. Hard, compact, yellowish-white to gray-white orbitoidal limestone, thin-bedded to thick-bedded and massive. Interbedded with soft to hard white calcareous shale (marl). Locally interbedded flows and intrusives of andesitic rocks. Thickness of formation obscured by intense deformation; probably several thousand feet. Unconformable on basic igneous and metamorphic complex and may be at least partly equivalent in age to the lower part of the Taog formation on northwest Leyte.	Bed str and lea par Dar on eve gen Ste pla of spa ing tur com she cru
8 VOLCANICS (OLIGO-MIOCENE TO RECENT)	Andesitic flows, cones, intrusives, tuff, and agglomerate. The flows and intrusives, dense and hard when fresh, are gray, fine- to medium-grained andesites. Locally the intrusives are porphyritic. No detailed information on the pyroclastics, but probably not as resistant to weathering as flows or intrusives. Volcanic rocks locally bleached and altered to a light-colored clay by continuing solfataric action, especially on high ridge about seven miles south-southwest of Burauen, on Leyte, and at various localities on Biliran Island. Sulphur locally present.	Flo int com fra flo les Flo cla nea lyi hav dip as fol imp er
9 BASIC IGNEOUS AND METAMORPHIC COMPLEX	Basalt, gabbro, peridotite, serpentine, argillite, schist, gneiss, quartz monzonite and diorite. Relative abundance of the various rock types is not well known; in general the basic igneous rocks probably predominate over the metamorphic rocks; the	Clo tur sha ser arg ten

n most dips ween 30° and . Lower part, bably sepa- ed from the er by an ular uncon- mity, is h contorted distrubed, h many steep s, much cturing and ttering.			
s commonly ongly folded faulted. At st the upper t of the am formation Samar, how- r, is only tly folded. ep dips in ces; zones closely ced shatter- and frac- ing are mon. Locally ared and shed.	Moderately rugged to very rugged hills and mountains with very steep slopes, and sharp, in places knife-edged ridges. Outcrops may be extensive on steep slopes; most numerous along streams. Limestones form prominent ridges and escarpments, very rugged and craggy, with many caves, especially north of Sohoton, and at Matuguinao in northern Samar. The Catubig River runs underground for about 3 miles in a limestone cavern area, from a point about 9 miles northeast of Matuguinao.	Hard massive limestones are excellent source for concrete aggregate, road metal, base course and surface course, and riprap. Some hard calcareous sandstone and conglomerate is a fair source of concrete aggregate and base course.	Most rock requ blasting. Tem usually will n except in stro zones.
ws and most rusives are monly closely ctured. Young ws probably s fractured. ws and pyro- stics may be rly flat- ng or may e initial s as great 35°. Locally, ding may have arted steep- dips.	Much of rugged central mountain range (maximum elevation 4,400 feet) reported to consist of volcanic cones. Many of them are probably not greatly modified by erosion. Young cones are very steep (35°) symmetrical, and smooth in major outline. Older eroded cones are only roughly conical, with very steep, deeply dissected slopes.	Massive, hard andesite is an excellent source of concrete aggregate, road metal, base course and surface course material, and riprap.	Weathered rock weathered to r well-drained, easily excavat scrapers, or d temporary exca without much s Fresh rocks. sives and many be drilled and ly where fract is widely spac tuff can be wo scrapers and d temporary exca shattered or w by solfataric
sely frac- ed, strongly ttered; pentine and illite in- sely sheared.	Rugged, steep mountains with sharp ridges. Landslides common, especially in areas underlain by serpentine or argillite.	Fresh andesite similar to that of Unit 8. Fresh gabbro and diorite similar to andesite; may be superior. Locally may be suit-	All rocks deep Weathered rock rocks of Unit ed or fresh ro ing and blasti shattered or s

ires drilling and porary excavation ot require support ngly shattered	Bearing strength moderate to high.	Well drained. Generally impermeable except for cavernous areas in limestone; underground drainage extensive through solution channels.
s. Rocks deeply eddish, granular, clay soil which is ed with hand tools, ozers. Walls of vations will stand upport. Flows and intru- agglomerates must blasted, especial- uring and jointing ed. Probably some rked with hand tools, ozers. Walls of vations will not require support except where rock is greatly here soft beds dip toward the excavation. Volcanics altered action can be easily excavated, but require much support.	Bearing capacity of weathered rocks low. Fresh flows and intrusives have high bearing strength; tuffs and agglomerates, low to moderate.	Generally well drained, both in weathered and fresh condition. Generally impermeable; probably some of the more recent volcanics are permeable.
ly weathered. similar to trap 8. Slightly weather- cks require drill- ng. Much rock is heared, and will	Weathered rocks have low bearing strength; fresh diorite and gabbro, very high; peridotite, argillite, and schist, moderate;	Weathered and fresh rocks generally well drained. Rocks generally impermeable, except along parts of fractured zones.

(LARGELY PRE-TERTIARY)	more acidic igneous rocks are rare. Intruded by andesites of different type from those of Unit 8. San Roque, on northeast coast of Leyte, are underla lite; quartzose chlorite schist; and soft, green, s tine. Diorite and peridotite reported from near Ma Leyte and on the Camotes Islands the complex is dom Nearly all the rock types present near Pambuhan Sur

Isolated hills between Palo and in by hard, slickensided argil- heared and slickensided serpen- litbog on Leyte. On northwest inantly basalt and peridotite. , on Samar.	able for heavy masonry. Argillite, schist, and peridotite generally suitable only for light construction. Serpentine unsuitable.	require suppor Serpentine, m easily.

CONFIDENTIAL

t when excavated. uch sheared, slides	serpentine, low, or very low if sheared.	

Prepared by U. S. Geological Survey
for Chief of Engineers, U. S. Army

PHILIPPINE ISLANDS 1:500,000

VEGETATION

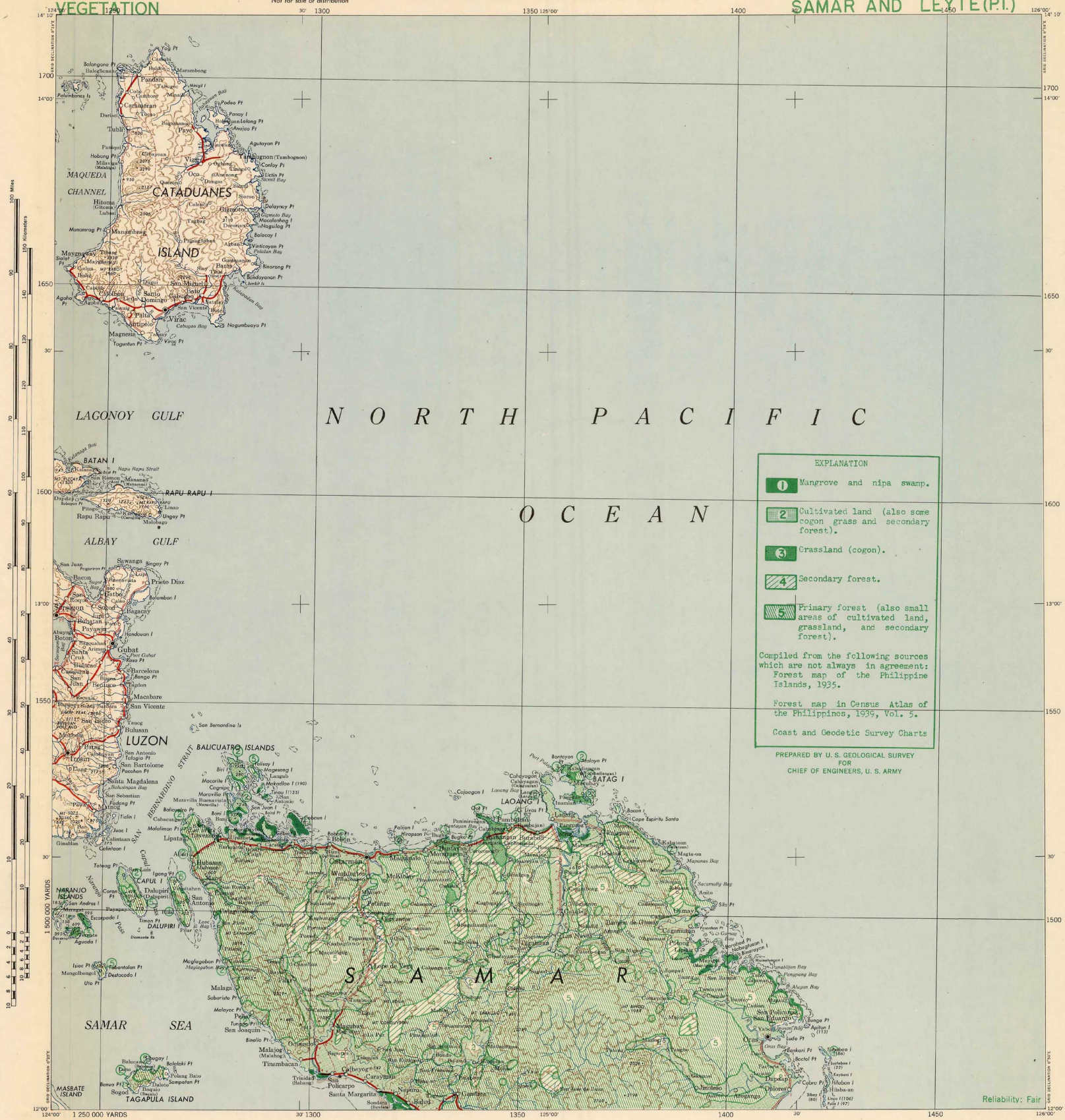
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SAN BERNARDINO STRAIT

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE(P.I.)



124°00' 1 250 000 YARDS 30' 1300 1350 125°00' 1400 30' 1450 126°00'

A.M.S. S401
First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944.
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LEGEND

Road, surfaced, all-weather
Road, partially surfaced, generally all-weather
Track, Trail
Road under construction, 1941
Boundary, International Treaty Limits
Boundary, Provincial
Boundary, Chartered City
Railroad, 3'6" gauge; with Station
Railroad, Less than 3'6" gauge
Railroad, Electric (ELECTRIFIED)
Telephone and Telegraph Line
Power Transmission Line
City, First Importance
City, Second Importance
City or Large Town
Small Town
Village or Settlement
Aerodrome, Auxiliary Landing Field
Seaplane Base, Auxiliary Anchorage
Principal Navigation Light
Radio Station
Telephone Station, Telegraph Station
Mud Flat, Tidal Flat
Mangrove

MANILA
DAVAO
Tagum
Peña
Kalan

Scale 1:500,000

10 8 6 4 2 0 10 20 Miles
10 8 6 4 2 0 10 20 30 Kilometers
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.

APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE
Do not use diagram except to obtain numerical value of angles

COVERAGE DIAGRAM

INDEX TO BOUNDARIES

INDEX TO ADJOINING SHEETS

1. USC&GS Charts, (Reliable survey)
2. Military Map of portion of Samar Island, 1:63,360 (Reconnaissance survey - reliability fair)
3. Luzon Oil Map, 1:200,000, (Reconnaissance map - reliability fair)
4. Sectional Aeronautical Chart, 1:600,000 (Compiled map - reliability fair)

PROVINCES
1. ALBAY
2. SORSOGON
3. SAMAR
4. MASBATE

Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

HEIGHTS IN FEET AND DEPTHS IN FATHOMS

90

PHILIPPINE ISLANDS 1:500,000

VEGETATION

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War and Navy Department Ag
Not for sale or distribut



encies only
ion

[redacted]

SAN BERNARDINO STRAIT

1350 125°00′

SECOND EDITION-AMS 2

ND 51-6

SAMAR AND LEYTE (P.I.)

1400 30′ 1450 126°00′

14° 10′

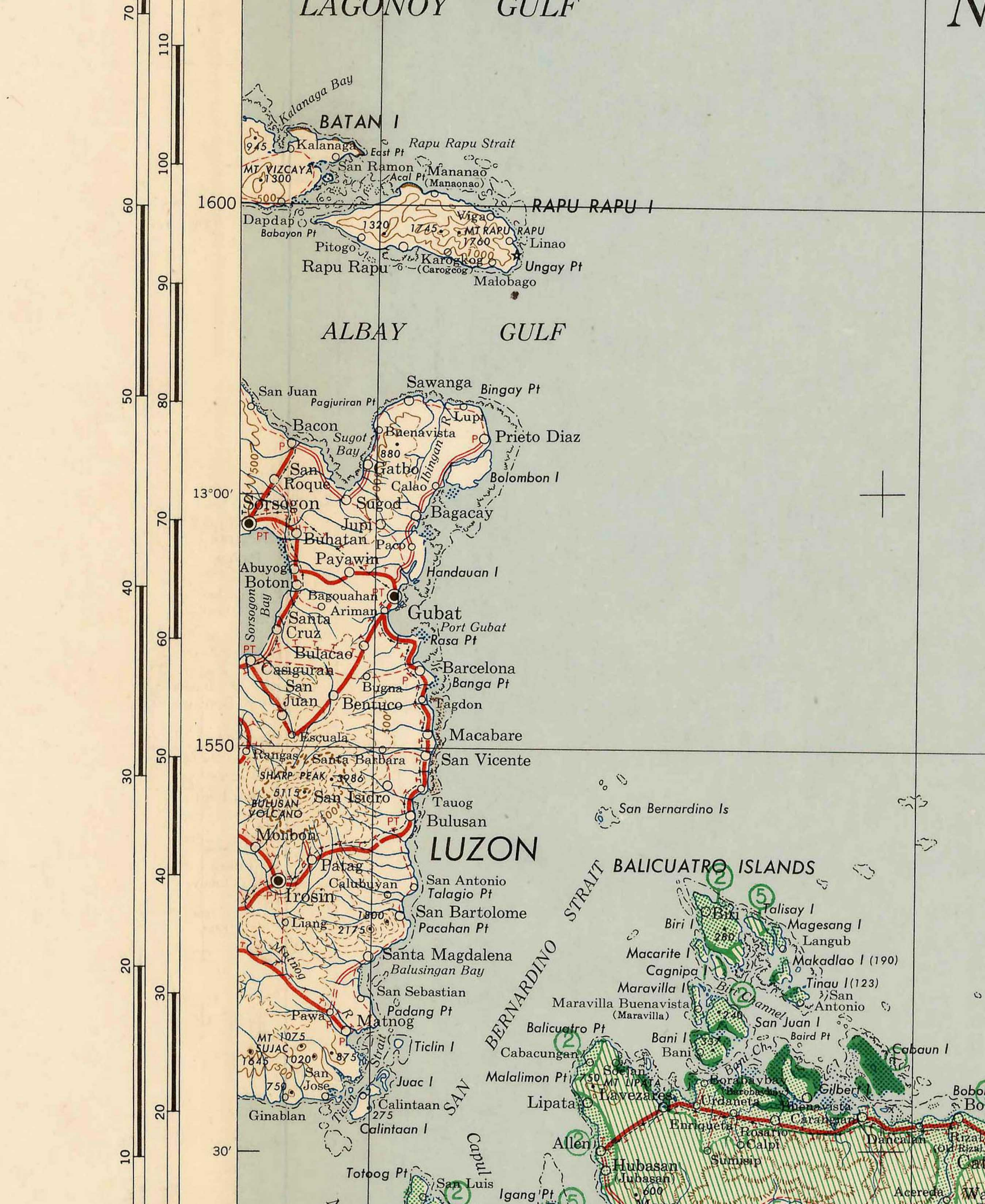
GRID DECLINATION 0°58′E

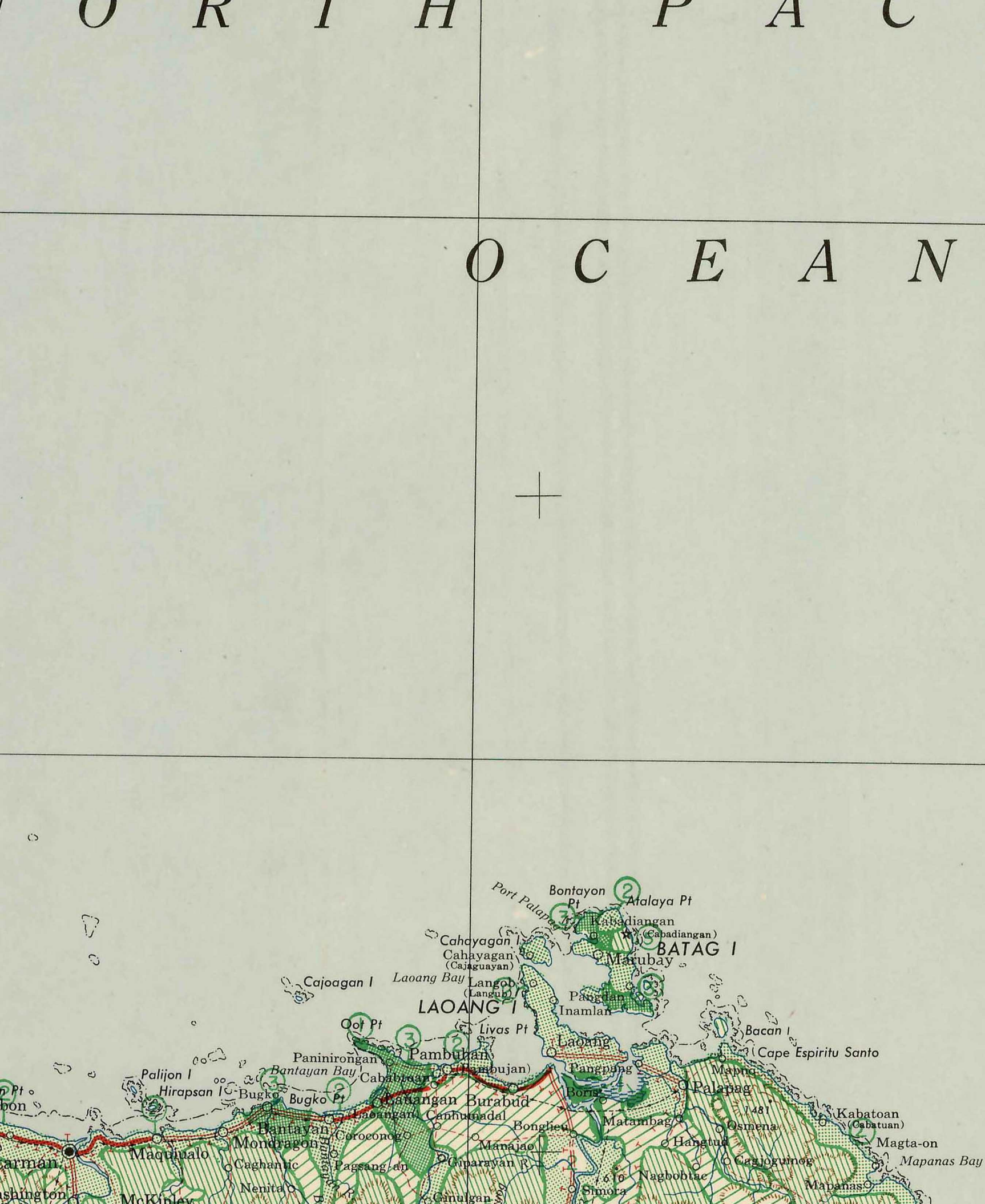
1700

14°00′

1650

30′


LAGONOY GULF
Kalanaga Bay
BATAN I
Kalanaga
East Pt
Rapu Rapu Strait
MT VIZCAYA
1300
San Ramon
Acal Pt
Mananao
(Manaonao)
1600
RAPU RAPU I
Dapdap
Babayon Pt
1320
1745
MT RAPU RAPU
1760
Viga
Linao
Pitogo
Karogkog
(Carogcog)
Rapu Rapu
Ungay Pt
Malobago
ALBAY GULF
San Juan
Pagjuriran Pt
Sawanga
Bingay Pt
Lupi
Bacon
Sugot Bay
Buenavista
Prieto Diaz
Ibingan R
880
Gatbo
Calao
Bolombon I
San Roque
13°00'
Sorsogon
Sugod
Bagacay
Juni
Buhatan
Paco
Payawin
Handauan I
Abuyog
Boton
Bagouahan
Ariman
Gubat
Port Gubat
Rasa Pt
Sorsogon Bay
Santa Cruz
Bulacao
Casigurán
Barcelona
Banga Pt
San Juan
Bugna
Bentuco
Tagdon
Escuala
Macabare
1550
Rangas
Santa Barbara
San Vicente
SHARP PEAK 3986
8115
BULUSAN VOLCANO
San Isicro
Tauog
Bulusan
San Bernardino Is
Monbon
LUZON
Patag
Irosin
Calubuyan
San Antonio
Talagio Pt
San Bartolome
1800
2175
Liang
Pacahan Pt
Matnog
Santa Magdalena
Balusingan Bay
San Sebastian
Padang Pt
Pawa
Matnog
MT SUJAC
1075
1020
875
1645
Ticlin I
Ticlin Strait
San Jose
750
Juac I
Calintaan
275
Calintaan I
Ginablan
30'
Totoog Pt
San Luis
Igang Pt
Capul
SAN BERNARDINO STRAIT
BALICUATRO ISLANDS
Talisay I
Biri
Biri I
Magesang I
280
Langub
Macarite I
Makadlao I (190)
Cagnipa I
Maravilla I
Tinau I (123)
Maravilla Buenavista
(Maravilla)
Bir Channel
San Antonio
240
San Juan I
Balicuatro Pt
Bani I
Baird Pt
Bani
Cabacungan
Cabaun I
Malalimon Pt
Soetan
MT LIPATA
1150
Borabaybay
Barobas Bay
Gilbert I
Lipata
Lavezares
Urdaneta
Buenavista
Enriqueta
Carabagan
Rosario
Allen
Calpi
Dancalan
Sumisip
Hubasan
(Jubasan)
600
Acereda


PACIFIC
OCEAN
Port Palapag
Bontayon Pt
Atalaya Pt
Kabadiangan
(Cabadiangan)
BATAG I
Marubay
Cahayagan
Cahayagan
(Cajaguayan)
Cajoagan I
Laoang Bay
Langob
(Langub)
Pangdan
Inamlan
LAOANG I
Oot Pt
Livas Pt
Laoang
Bacan I
Cape Espiritu Santo
Paninirongan
Pambuhan
(Pambujan)
Pangpang
Mapno
Palijon I
Bantayan Bay
Cabahtoan
Hirapsan I
Bugko
Bugko Pt
Burabud
Boris
Palapag
Laoangan
Canhumadal
Matambag
Kabatoan
(Cabatuan)
Bantayan
Coroconog
Bonglieu
Osmena
Mondragon
Manajao
Hangtud
Magta-on
Maqupalo
Caghantic
Giparayan R.
Cagjoguinog
Mapanas Bay
Pagsang-an
Nagbobtac
Nenita
Simora
Mapanas
Ginulgan

I F I C

EXPLANATION

1 Mangrove and nipa swamp.

2 Cultivated land (also some cogon grass and secondary forest).

3 Grassland (cogon).

4 Secondary forest.

5 Primary forest (also small areas of cultivated land, grassland, and secondary forest).

Compiled from the following sources which are not always in agreement:

Forest map of the Philippine Islands, 1935.

Forest map in Census Atlas of the Philippines, 1939, Vol. 5.

Coast and Geodetic Survey Charts

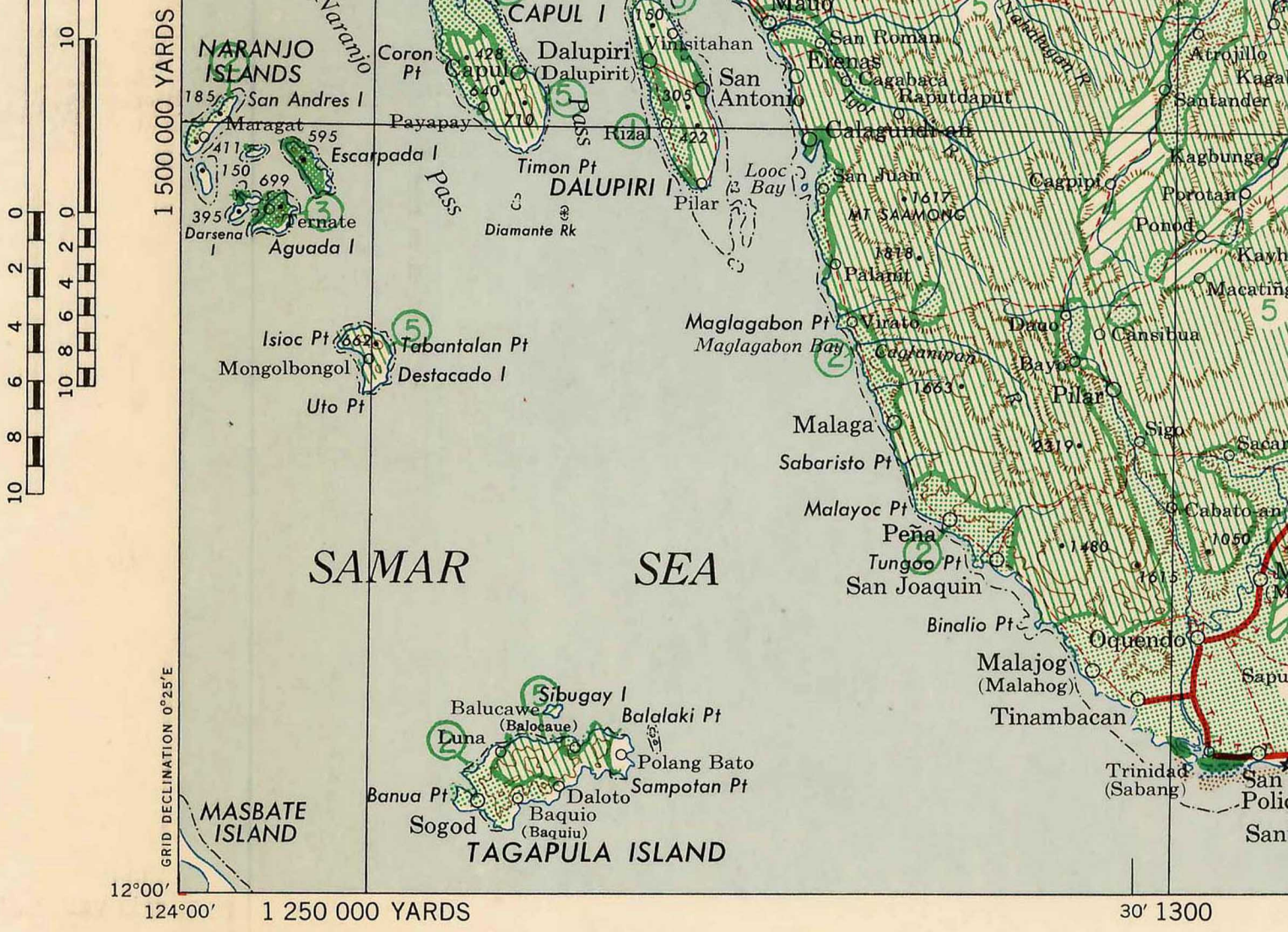
PREPARED BY U. S. GEOLOGICAL SURVEY
FOR
CHIEF OF ENGINEERS, U. S. ARMY

1600

13°00′

1550

30′



A.M.S. S401

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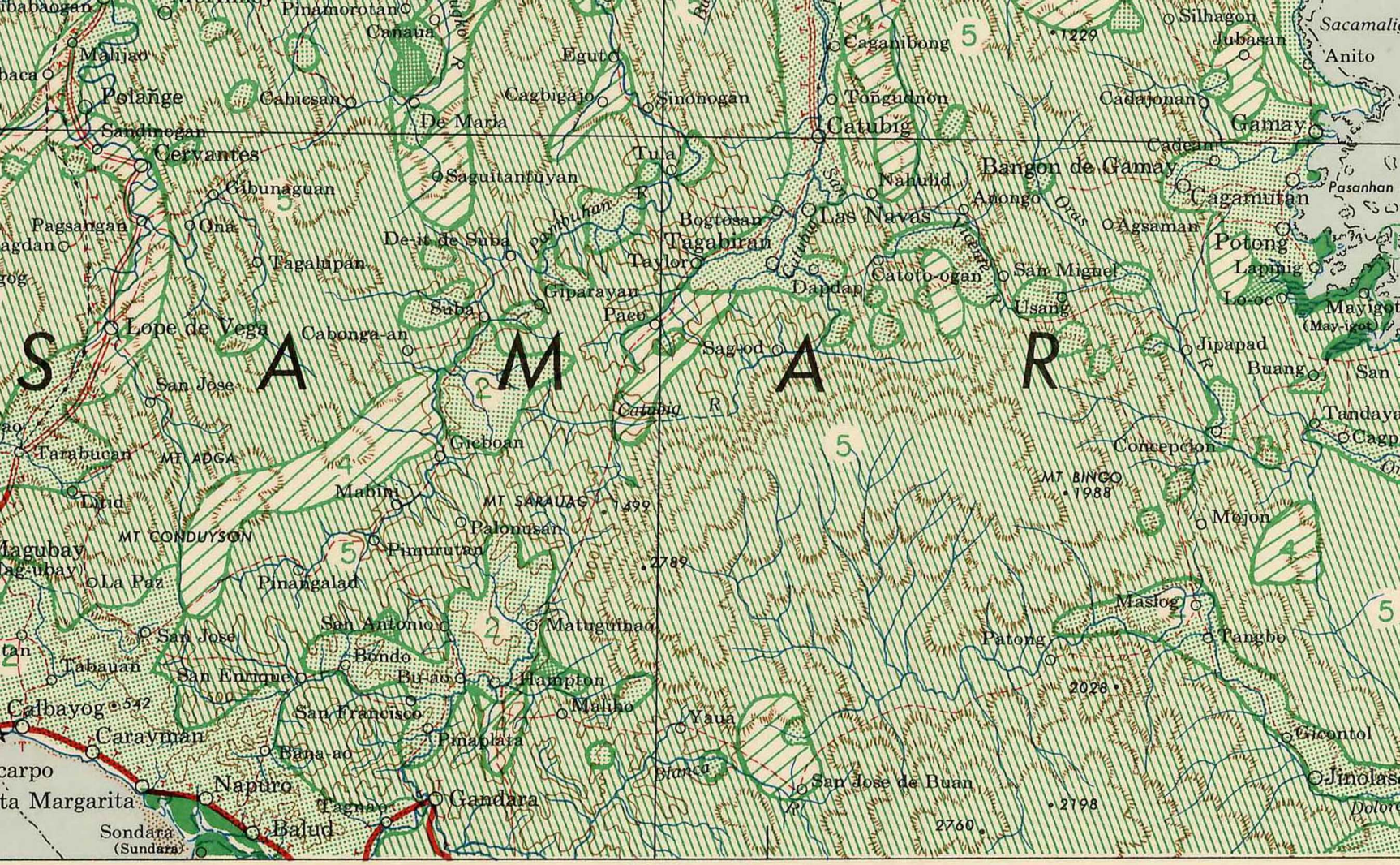
CONVERSION GRAPH
NOT at the scale of the map.

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Feet: 10,000; 9,000; 8,000; 7,000; 6,000; 5,000; 4,000; 3,000; 2,000; 1,000; 0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line

- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station — P T
- Mud Flat, Tidal Flat
- Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

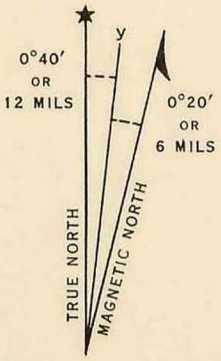
10000 0 10000 20000 30000 Yards

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS, WASHINGTON, D. C.



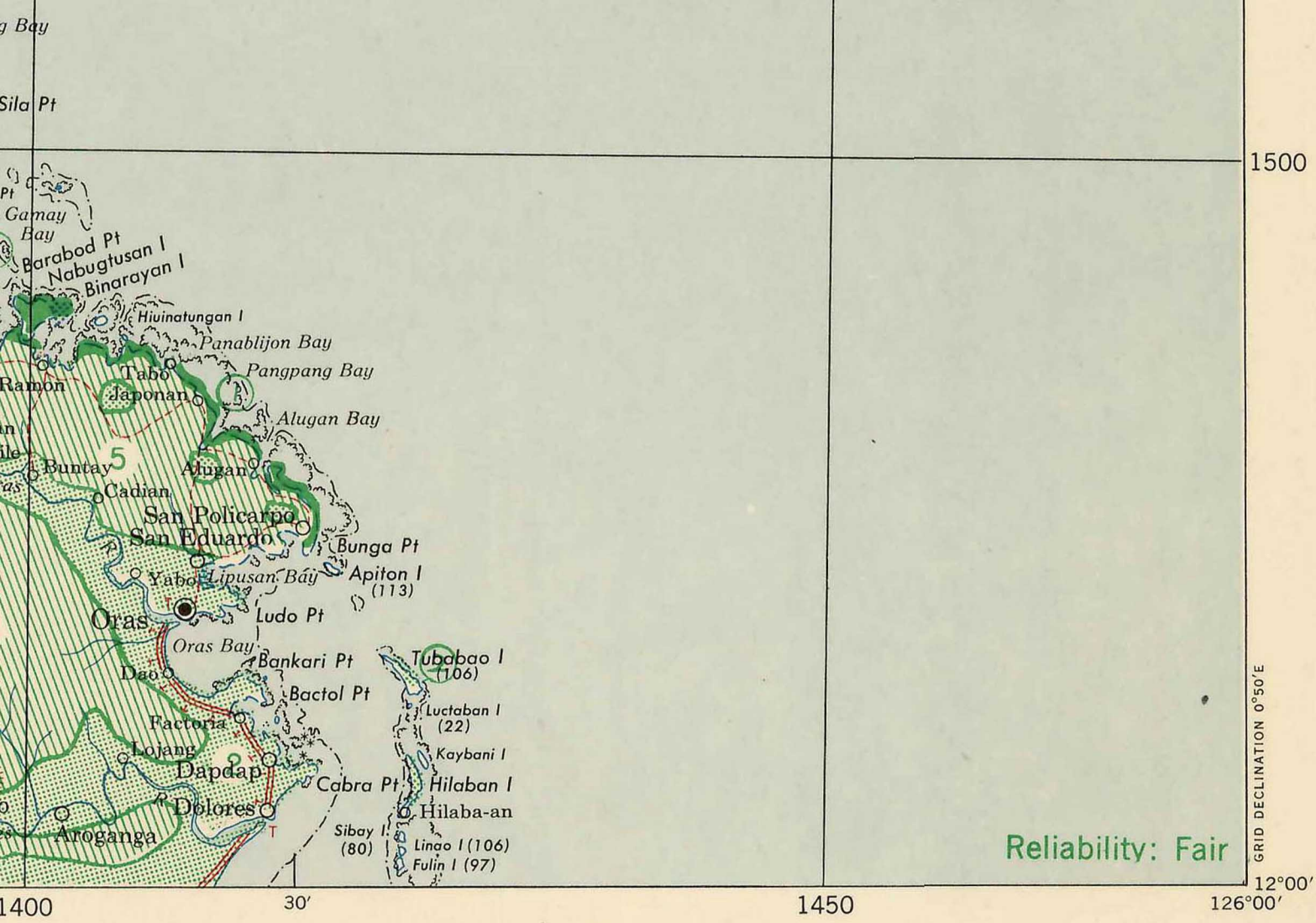
APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1′ INCREASE

Do not use diagram except to obtain numerical value of angles

90

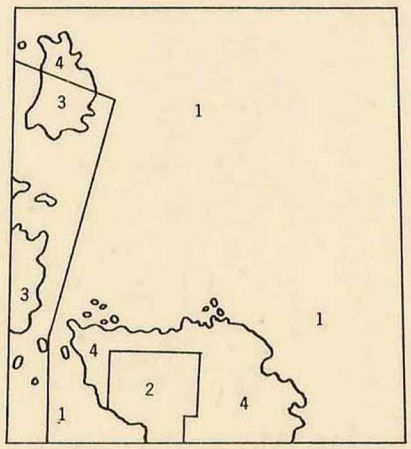
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS



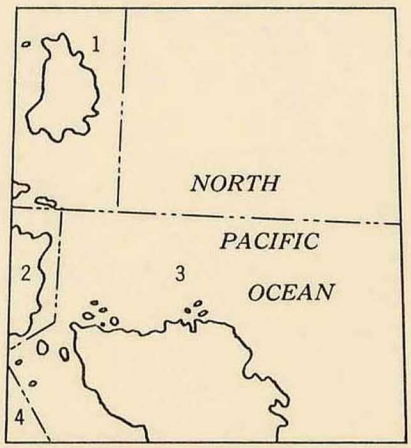
ARMY MAP SERVICE, U. S. ARMY, WASHINGTON, D. C., 112090
9-44 1944

COVERAGE DIAGRAM



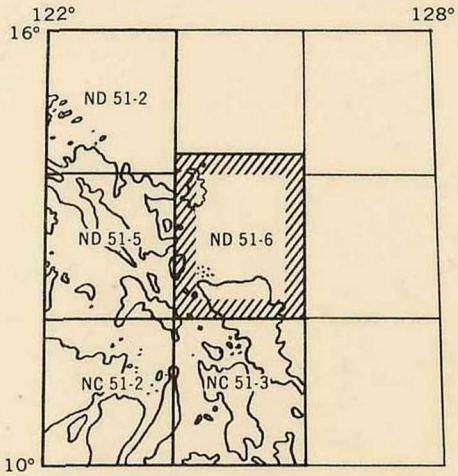
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INDEX TO BOUNDARIES



PROVINCES
1. ALBAY
2. SORSOGOR
3. SAMAR
4. MASBATE

INDEX TO ADJOINING SHEETS



Broken Shorelines Indicate Mangrove

SAN BERNARDINO STRAIT, PHILIPPINE ISLANDS

N1200-E12400/210x200

[redacted]

PHILIPPINE ISLANDS 1:500,000

VEGETATION

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LEYTE ISLAND

SECOND EDITION-AMS 2

NC 51-3

SAMAR AND LEYTE (P.I.)



1 250 000 YARDS

Scale 1:500,000

CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

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APPROXIMATE MEAN DECLINATION 1944 FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE
Do not use diagram except to obtain numerical value of angles

CONVERSION GRAPH NOT at the scale of the map.

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- Road, partially surfaced, generally all-weather
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- Road under construction, 1941
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- Boundary, Chartered City
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Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

A.M.S. S401

First Edition (AMS 1), 1943.

Second Edition (AMS 2), 1944.

Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D. C., 1944. Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 1936; 4422, 1908; 4423, 1936; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Maps of Cebu, Masbate, Burias, Ticao, 1:200,000, Nat'l Devel. Co., 1940. Military Map of Portion of Samar Island, 1:63,360, O. C. E. O., Phil. Div., No. 1, 1928. Standard Recon. Map, Surigao & Augusan, 1:100,000, Inc. Co., No. 1. Vols. I & V, Commission of the Census, Commonwealth of the Philippines, 1940. Intelligence Data, 1943. Roads from: Mobilgil Road Map of the P. I., 1:1,100,000. Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road Map of the Philippines, 1:500,000. Bur. Pub. Works, Nos. 7 & 8, 1941. Tel. & Tel. from: Communication Map of the P. I., 1:400,000, Hq. Mil. Int., Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000, USC & GS, No. 100, 1933.

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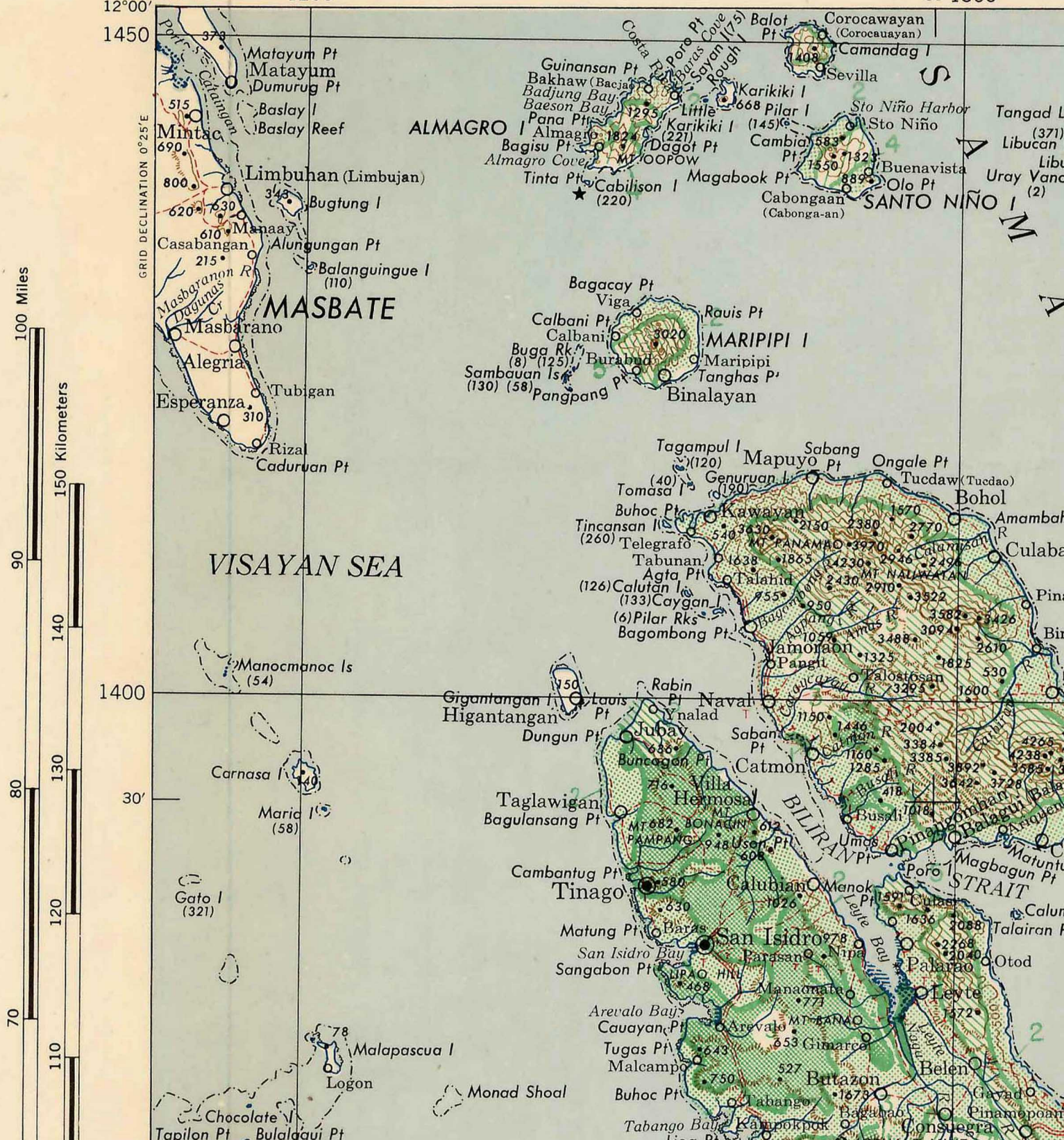
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS

PHILIPPINE ISLANDS 1:500,000

VEGETATION

For us
War and Navy Depa
Not for sale o



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r distribution

LEYTE ISLAND

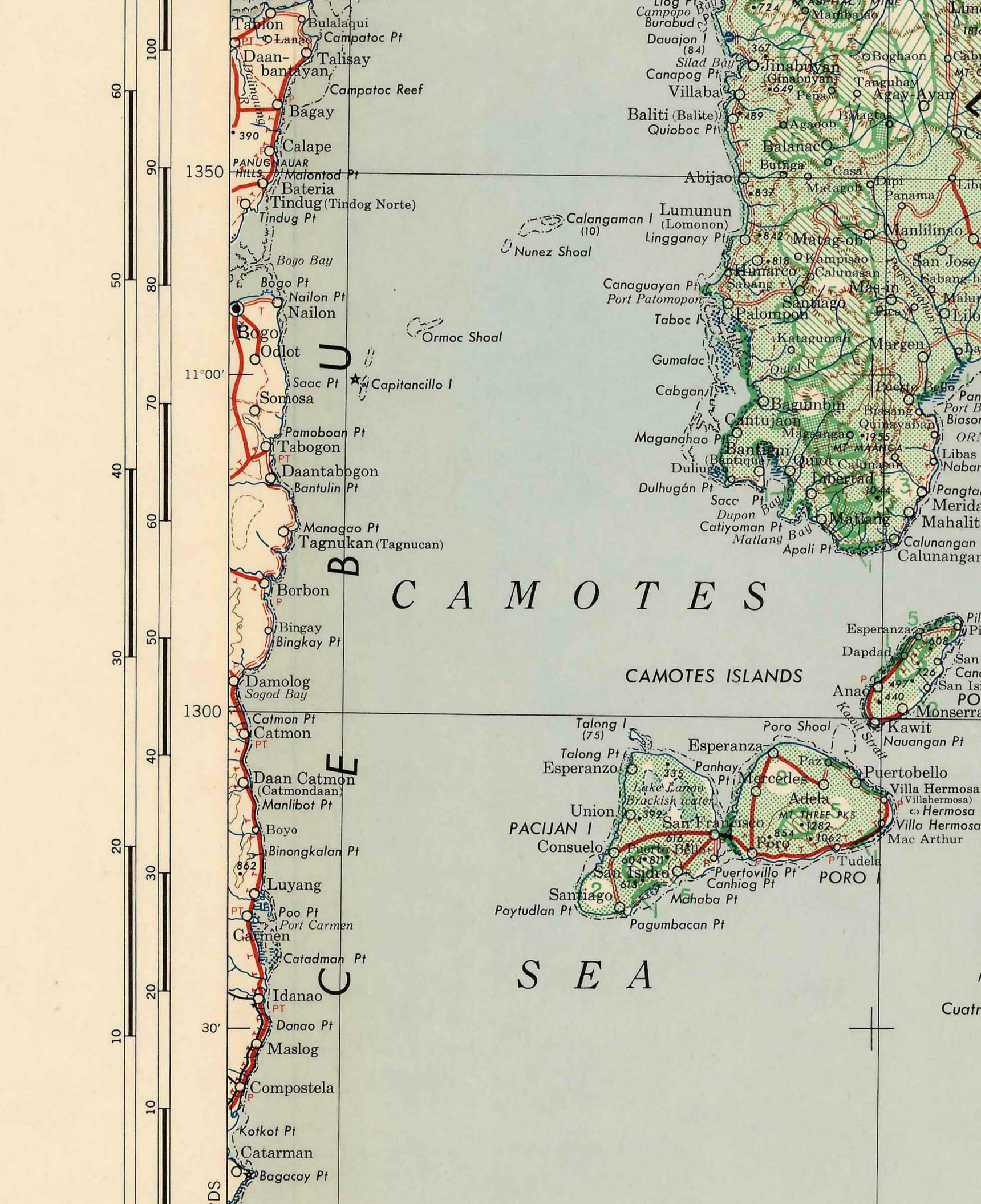

1350
125°00′
Pagsanjan
Dapdap
Tarangnan
Libucan
Sta Cruz
Palencia
Hernandez
San Fernando
Albalate
Malino
Lolugayan
Motiong
Catbalogan
Wright
Jiabong
Pangdan
Malubago
Hinabangan
San Sebastian
Basiao Is
Jitaasan
Patong
Calaya-an
Calbiga
Tinigo
Buluan
Jubasan
Abaca
Quintarcan
Buaya
Villareal
San Fernando
Lale
Nonoc
Bino-ongan
Talalora
Planidel
Mulbug
Sta Rita
Tomandog
Manunca
Navahay I
Babatngon
Malibago
La Paz
Bagalibas
Pinogahan
Sohoton
Sta Cruz
San Isidro
Sta Elena
Buenavista
Balayon
New San Agustan
Burgos
Magallanes
Barugo
Calingcaguing
Carigara
Kabalawan
Nouvilas
Basey
Oce
Culasian Pt
CARIGARA BAY
BILIRAN ISLAND
Caibiran
Naparican Pt
Sua
Baclayan
Banquel
Aocon Is
Mabini
Olayan
Burgos
Calubian Pt
Bacsal Is
Daram Channel
Dulugdug Pt
Nabatas Pt
Diutay Pt
Malagining Pt
Janabatas Channel
Calagúan
Canauay
Dabun I
Baluarte Pt
Kalangawan
Nabung Cove
Banúg Pt
Duka
Impo
Culasian Pt
Sta Cruz
Ibog Lake
Kabalawan
Cabalawan
Mongabong
Uban Pt
Sta Elena
Buenavista
New San Agustan
Burgos
Magallanes
Basey
Nouvilas
Oce
Balayon
Sohoton
Pinogahan
La Paz
Bagalibas
Tomandog
Manunca
Navahay I
Sta Rita
Mulbug
Calbiga
Patong
Calaya-an
Hinabangan
San Sebastian
Jitaasan
Jubasan
Bulu

SECOND EDITION-AMS 2

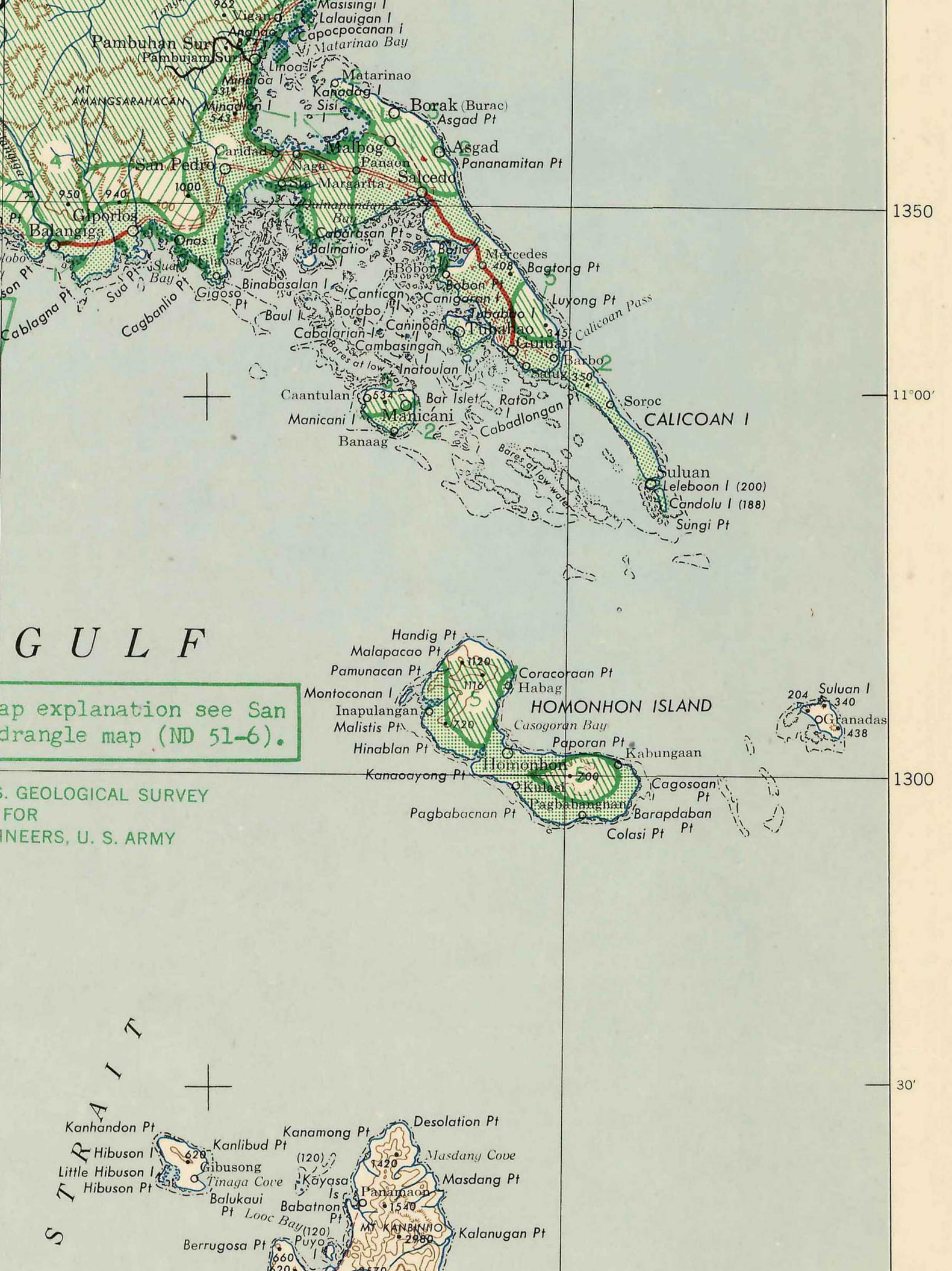
NC 51-3

SAMAR AND LEYTE (P.I.)



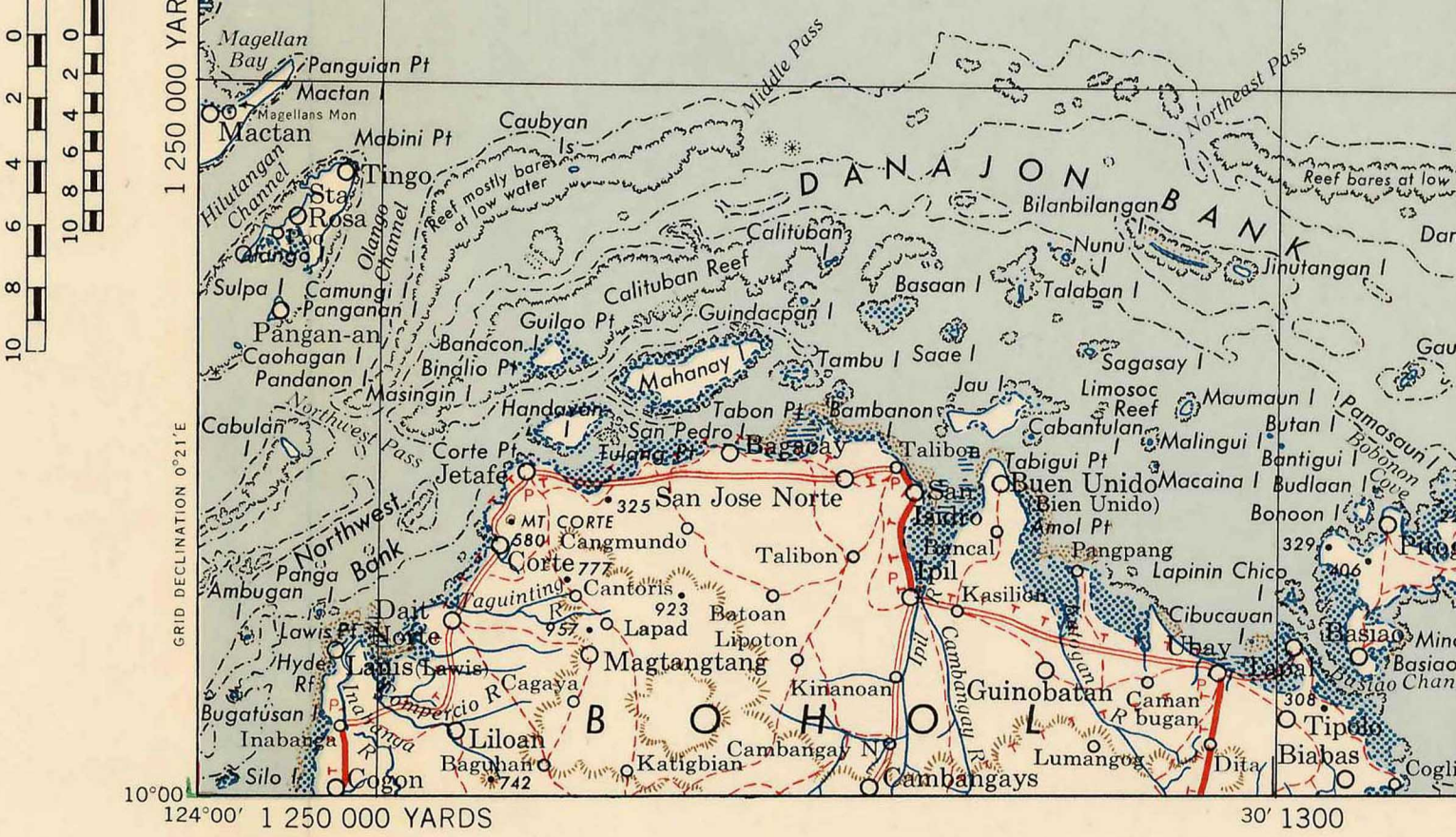

Tablon
Bulalaqui
Lanao
Campatoc Pt
Daan-bantayan
Talisay
Campatoc Reef
Bagay
Calape
PANUGNAUAR HILLS
Malontod Pt
Bateria
Tindug (Tindog Norte)
Tindug Pt
Bogo Bay
Bogo Pt
Nailon Pt
Nailon
Bogo
Odlot
Saac Pt
Capitancillo I
Somosa
Pamoboan Pt
Tabogon
Daantabogon
Bantulin Pt
Managao Pt
Tagnukan (Tagnucan)
Borbon
Bingay
Bingkay Pt
Damolog
Sogod Bay
Catmon Pt
Catmon
Daan Catmon (Catmondaan)
Manlibot Pt
Boyo
Binongkalan Pt
Luyang
Poo Pt
Port Carmen
Carmen
Catadman Pt
Idanao
Danao Pt
Maslog
Compostela
Kotkot Pt
Catarman
Bagacay Pt
Ormoc Shoal
Nunez Shoal
Calangaman I (10)
Lumunun (Lomonon)
Lingganay Pt
Canaguayan Pt
Port Patomopon
Taboc I
Gumalac
Cabgan
Maganahao Pt
Dulhugán Pt
Sacc Pt
Dupon Bay
Catiyoman Pt
Matlang Bay
Apali Pt
Liog Pt
Campopo Bay
Burabud Pt
Daujon I (84)
Silad Bay
Canapog Pt
Villaba
Baliti (Balite)
Quioboc Pt
Abijao
Balanac
Butnga
Casa
Matagob
Panama
Manlilinao
Matag-ob
San Jose
Kampisao
Himarco
Calunasan
Sabang
Mac-in
Santiago
Palompon
Kataguman
Margen
Quiot R
Puerto Bello
Baguinbin
Cantujaon
Biasang
Quinayaban
Bantigui (Bantique)
Quiot
Calunasan
Libertad
Matlang
Merida
Mahalit
Calunangan
CAMOTES
CAMOTES ISLANDS
Esperanza
Dapdad
Anao
Kawit
Nauangan Pt
Monserrat
Kawit Strait
Poro Shoal
Talong I (75)
Talong Pt
Esperanzo
Panhay Pt
Paz
Mercedes
Puertobello
Villa Hermosa (Villahermosa)
Lake Lanao
Brackish water
Adela
Union
San Francisco
MT. THREE PKS
Villa Hermosa
Mac Arthur
PACIJAN I
Consuelo
Poro
Tudela
PORO I
San Isidro
Puertovillo Pt
Canhiog Pt
Santiago
Mahaba Pt
Paytudlan Pt
Pagumbacan Pt
BOHOL SEA
1350
1300
11°00'
30'


LEYTE
1 Mangrove and nipa swamp.
2 Cultivated land.
3 Grassland (cogon)
4 Secondary forest.
5 Primary forest.
NOTE: For detailed m
Bernardino Strait qua
PREPARED BY U. S
CHIEF OF ENG
Tacloban
Palo
Tanauan
Ormoc
Baybay
Carigara
Abuyog
Dulag
Burauen
Jaro
Tunga
Alangalang
Mudburon
Marasbaras
Sta Fe
Malirong
Pastrana
Bolongtd
Sta Elena
San Isidro
Kiling
Dagami
Tabontabon
Tolosa
Guimarona
Buri
Calbasag
San Roque
San Jose
Julita
San Andres
Esperanza
Cabacungan
Rizal
Mayorgac
Bincay
La Paz
Caluslugan
Buracan
Hiloktogan
Palale
Tarragona
Sungi
Bito
Bugno
Talisayan
Hilapnitan
San Augustin
Bartoline
Caridad
Damulaan
(Damula-an)
Tinag-an
Albuera
Tabgas
Benulho
Balugo
Ipil
Boroc
Dolores
Patag
Valencia
Cabulihan
Aquiting
Buenavista
Sta Cruz
Tingib
Binabaan
Yapad
Lauan
Tankip
Patoc
Hitomhag
Mahilaom
Pahagan
Capatgan
Lubi
Candonaya
Matagpa
Bangdan
Batog
Sta Ana
Bagacay
Libas
Telegrafo
Mercaduhay
Mat-i
Gubang
Punta
Catarman Pt
Libagong
Union
Kandadam
Gabas
Balocawe
Pondoc
Aslum
Dayas
Pagsanyan
Lawaan
Himamara
Humirog
Guintonoan
Anibongon
Patong
Hibagwan
Oguis
Mahaplag
Hubas
Cabayagon
Guadalupe
Plaridel
Bitahuan
(Bitanhuan)
Cunalom
(Conalum)
Inopacan
Amogotada Pt
Bulacan
Batuan
Hindang
Binobolang Pt
Owak
Sta Margarita
Hila-an
San Isidro
Tuguipa
Hilongos
Suba
Sogod
Malansa
Consolacion
Inalaran
Pagacay
Kadiad
Malupao
Himakilo
Badiangon
Sogod
Cabugan Grande I
Cabugan Chico I
Saingan Pt
Kanipaan (Canipa-an)
Hinunangan
Hinunangan Bay
Pandan Pt
Bugho Pt
Silago
Sudmon
Lagoma
(Lagome)
Pelada Rock
Hingatungan
Hingatungan Pt
Kikilo
Hinunucan Pt
San Roque
Osmeña
Taytay Pt
Salacot Pt
Tangbo Pt
Legaspi
Nouvilas
Binatac Pt
Jinamoc I
Borac Pt
Cataisan Pt
Diyo I
Punubulu I
Calowayan
Osmeña
Camoropudan Is
Iris Shoal
San Pedro Bay
Egbert Shoals
Palo Reef
Binocyahan
Camiris Pt
Badungbadung Raso I
Pinanitinan
Aporoo I
Lauaan I
Sto Niño
Cawiran
Mantuaca Pt
Alabat Pt
Capines Pt
Calianan Shs
Mariguitdaquit
Vigia Pt
Malaguikay
Lauan Bay
Lauaan Bay
Binocyahan
Legaspi
Daquio I
(40)
Mahaba I
(137)
Apit I
(150)
Himuquitan I
(328)
Catmon Hill
Mt Catmon
Mt Maagonoc
Mt Majunag
Mt Lobi
Mt Cancajanag
Mt Banao
Mt Laad
Mt Mamban
Mt Badian
Mt Pina
Mt Tinagan
Mt Caanisilagan
Mt Palanas
Mt Calarabayan
Mt Lunas
Mt Bato
Mt Tabaan
Mt Panasugan
Mt Maganian
Mt Panjongon
Mt Daogdaog
Mt Quinasagan
Mt Calanican
Mt Sacnirante
Mt Bidyebang
Mt Solsogon
Mt Bacuit
Mt Milo
Mt Nacolod
Mt Ilihan
Mt Abuyog
Mt Ilaye
Alajag
Kamansi
Kaghaly
Patong
Amahit
San Miguel
San Antonio
Dirit
Godela
Legaspi
Osmeña
Sharp Pk
Round Pk
Lauaan I
Lauaan Bay
Hinunangan Bay
Leyte Gulf
San Pedro Bay
Bernardino Strait
Tungca R
Cantugon R
Rigbaw R
Dirit R
Legaspi R
Binahaan R
Tankip R
Danao R
Lubi R
Jagolon R
Marabang R
Talisay R
Gilbuga R
Bucan R
Hiloktogan R
Balutaquit R
Maya R
Lake Bito
Bito R
Pangon R
Hiya R
Paybongdan R
San Juan R
Bitahuan R
Tubauan R
Inopacan R
Batuan R
Hilongos R
Sta Margarita R
Bulao R
Magaso R
Lauaan R
Hinunucan R
Legaspi R
Sitaelo R
Lagoma R
Cadacan R
Pagsanyan R
Union R
Lawaan R
Dayas R
Aslum
Pondoc
Tangbo Pt
Salacot Pt
Taytay Pt
Osmeña
San Roque
Hinunucan Pt
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Sogod Pt
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Cabugan Chico I
Saingan Pt
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Hinunangan
Hinunangan Bay
Pandan Pt
Bugho Pt
Binocyahan
Lauaan I
Lauaan Bay
Camiris Pt
Badungbadung Raso I
Pinanitinan
Aporoo I
Sto Niño
Cawiran
Mantuaca Pt
Alabat Pt
Capines Pt
Calianan Shs
Mariguitdaquit
Vigia Pt
Malaguikay
Lauan Bay
Legaspi
Daquio I
(40)
Mahaba I
(137)
Apit I
(150)
Himuquitan I
(328)
Catmon Hill
Mt Catmon
Mt Maagonoc
Mt Majunag
Mt Lobi
Mt Cancajanag
Mt Banao
Mt Laad
Mt Mamban
Mt Badian
Mt Pina
Mt Tinagan
Mt Caanisilagan
Mt Palanas
Mt Calarabayan
Mt Lunas
Mt Bato
Mt Tabaan
Mt Panasugan
Mt Maganian
Mt Panjongon
Mt Daogdaog
Mt Quinasagan
Mt Calanican
Mt Sacnirante
Mt Bidyebang
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Mt Bacuit
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Mt Nacolod
Mt Ilihan
Mt Abuyog
Mt Ilaye
Alajag
Kamansi
Kaghaly
Patong
Amahit
San Miguel
San Antonio
Dirit
Godela
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Osmeña
Sharp Pk
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Lauaan I
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Tungca R
Cantugon R
Rigbaw R
Dirit R
Legaspi R
Binahaan R
Tankip R
Danao R
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Marabang R
Talisay R
Gilbuga R
Bucan R
Hiloktogan R
Balutaquit R
Maya R
Lake Bito
Bito R
Pangon R
Hiya R
Paybongdan R
San Juan R
Bitahuan R
Tubauan R
Inopacan R
Batuan R
Hilongos R
Sta Margarita R
Bulao R
Magaso R
Lauaan R
Hinunucan R
Legaspi R
Sitaelo R
Lagoma R
Cadacan R
Pagsanyan R
Union R
Lawaan R
Dayas R
Aslum
Pondoc
Tangbo Pt
Salacot Pt
Taytay Pt
Osmeña
San Roque
Hinunucan Pt
Kikilo
Hingatungan
Hingatungan Pt
Pelada Rock
Lagoma
Silago
Sudmon
Badiangon
Sogod
Sogod Pt
Cabugan Grande I
Cabugan Chico I
Saingan Pt
Kanipaan (Canipa-an)
Hinunangan
Hinunangan Bay
Pandan Pt
Bugho Pt



ap explanation see San
drangle map (ND 51-6).

S. GEOLOGICAL SURVEY
FOR
INEERS, U. S. ARMY



A.M.S. S401

First Edition (AMS 1), 1943.
Second Edition (AMS 2), 1944.

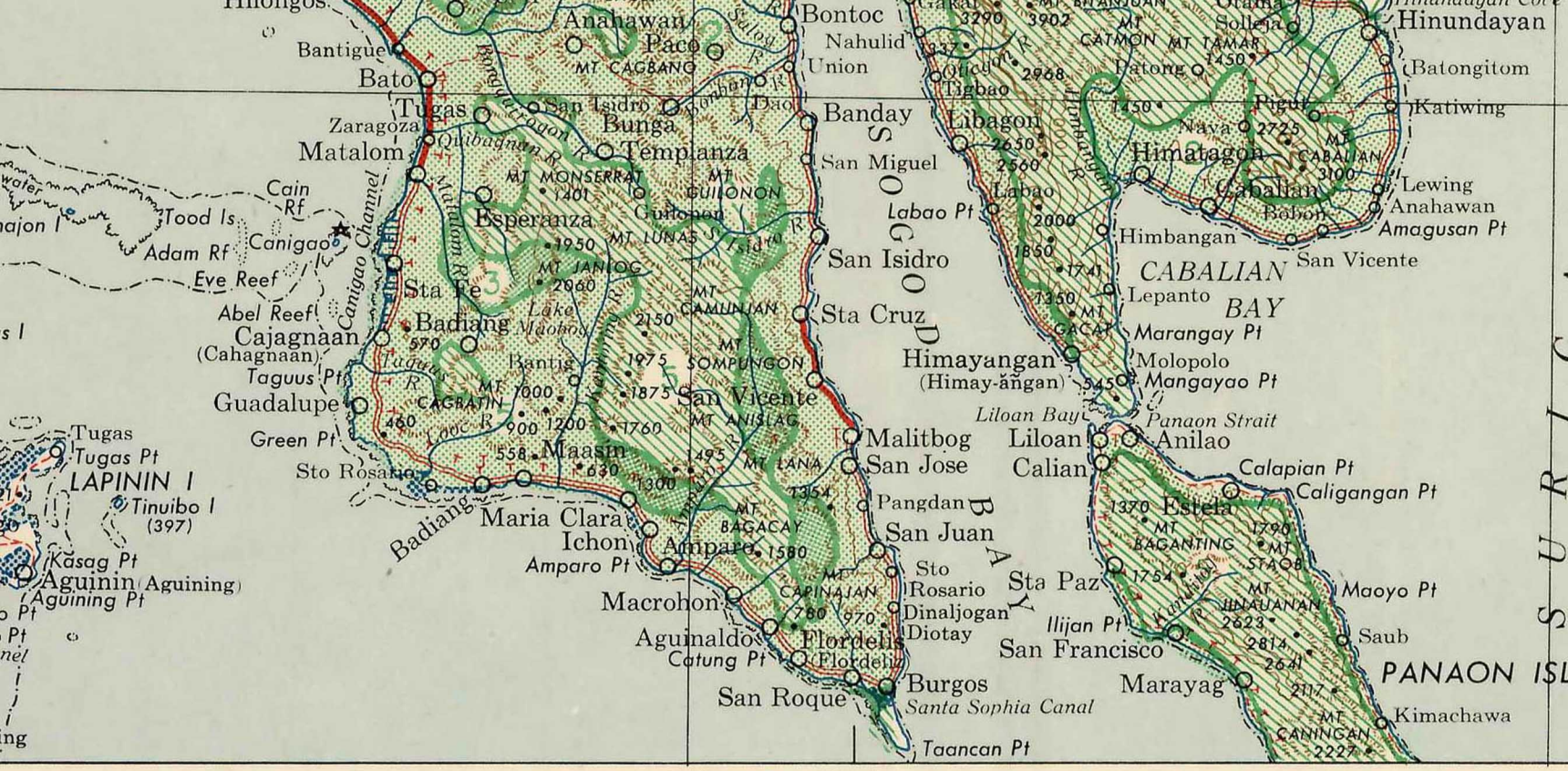
Prepared under the direction of the Chief of Engineers, U. S. Army, by the Army Map Service (AMRM), U. S. Army, Washington, D
Compiled from Sec. Aero. Chart, 1:600,000, USC & GS, Nos. 2, 3, 1941. USC & GS Charts, 4405, 1937; 4418, 1915; 4420, 19
1908; 4423, 1938; 4424, 1940; 4425, 1910; 4426, 1915; 4427, 1910; 4429, 1940; 4603, 1936; 4629, 1913. Philippin
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P. I., 1:1,100,000, Standard Vacuum Oil Co., P. I., 1941. Philippine Islands, 1:200,000, USC & GS, 1932-1940. Official Road M
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Phil. Dept., Nos. CM 15-1, CM 15-2, 1931 (corrected to 1940, AMS). Transmission Lines from: Philippine Islands, 1:1,000,000,
No. 100, 1933.

CONVERSION GRAPH
NOT at the scale of the map.

Meters	Feet
3,000	10,000
	9,000
2,500	8,000
	7,000
2,000	6,000
1,500	5,000
	4,000
1,000	3,000
500	2,000
	1,000
0	0

LEGEND

- Road, surfaced, all-weather
- Road, partially surfaced, generally all-weather
- Track, Trail
- Road under construction, 1941
- Boundary, International Treaty Limits
- Boundary, Provincial
- Boundary, Chartered City
- Railroad, 3'6" gauge; with Station
- Railroad, Less than 3'6" gauge
- Railroad, Electric — ELECTRIFIED
- Telephone and Telegraph Line
- Power Transmission Line
- City, First Importance — MANILA
- City, Second Importance — DAVAO
- City or Large Town — Tagum
- Small Town — Peña
- Village or Settlement — Kalan
- Aerodrome, Auxiliary Landing Field
- Seaplane Base, Auxiliary Anchorage
- Principal Navigation Light
- Radio Station
- Telephone Station, Telegraph Station (P, T)
- Mud Flat, Tidal Flat
- Mangrove



Scale 1:500,000

10 8 6 4 2 0 10 20 Miles

10 8 6 4 2 0 10 20 30 Kilometers

10000 0 10000 20000 30000 Yards

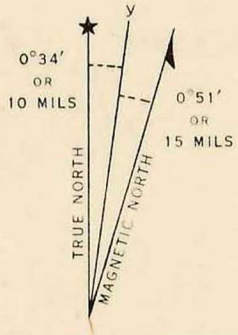
CONTOUR INTERVAL 500 FEET

POLYCONIC PROJECTION

FIFTY THOUSAND YARD PHILIPPINE POLYCONIC GRID
THE LAST THREE DIGITS OF THE GRID NUMBERS ARE OMITTED

NOTE: OFFICERS USING THIS MAP WILL MARK HEREON CORRECTIONS AND ADDITIONS WHICH COME TO THEIR ATTENTION AND MAIL DIRECT TO THE CHIEF OF ENGINEERS WASHINGTON, D. C.

. C., 1944.
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q. Mil. Int.,
USC & GS,



APPROXIMATE MEAN DECLINATION 1944
FOR CENTER OF SHEET
ANNUAL MAGNETIC CHANGE 1' INCREASE

Do not use diagram except to obtain numerical value of angles

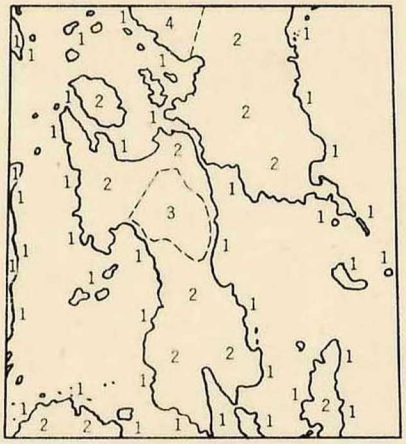
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HEIGHTS IN FEET AND DEPTHS IN FATHOMS

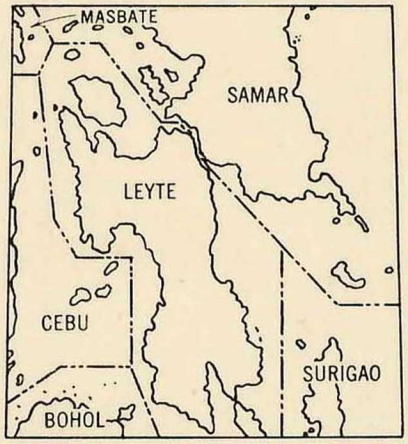


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9-44 1944

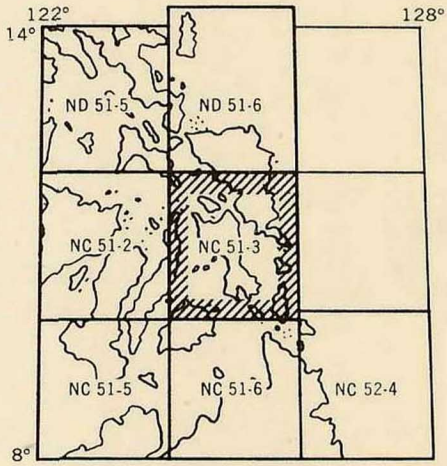
COVERAGE DIAGRAM



INDEX TO BOUNDARIES



INDEX TO ADJOINING SHEETS



1. USC&GS Charts, (Reliable survey)
2. Sectional Aeronautical Charts, 1:600,000 (Compiled map - reliability fair)
3. Philippine Is. USC&GS, (Compiled map - reliability fair)
4. Military Map of Portion of Samar, 1:63,360 (Reconnaissance survey - reliability fair)

Broken shorelines indicate mangrove

LEYTE ISLAND, PHILIPPINE ISLANDS

N1000-E12400/200

SAMAR AND LEYTE (P.I.)

VEGETATION

Reliability: Good

Map No. and Vegetation Type	Distribution	Description	Clearing and Grubbing	Uses	Effects on Military Operations: Movement	Effects on Military Operations: Observation	Effects on Military Operations: Concealment
SANDY BEACH Not shown on map; for locations, consult terrain sheets in this folio, C. and G.S. charts, or Coast Pilot and other Intelligence reports.	Beaches commonly narrow; in places only a few yards wide. On bold coasts the inland flora may grow to the sea; no distinct beach flora present. Settlements common; in many places original forest has been cleared for cultivation (see Cultivated Land). In places Casuarina forests occupy narrow belts along coast, and small pure stands may also occur on sandy flood plains of larger rivers. Elsewhere are several kinds of scattered trees; the pandan, or screw pine, may be abundant.	Casuarina type. Casuarina are medium-sized trees, 60 to 100 feet tall and 8 inches to 2 feet or more in diameter. Little undergrowth other than Casuarina seedlings; ground carpeted with fallen twigs. Spacing of trees is irregular; but canopy generally fairly continuous. Casuarina resembles a pine, and can be recognized from considerable distance offshore. Other types. Other scattered trees commonly have fairly thick tangled undergrowth of low shrubs, vines, and creepers. The pandan is low, scrubby trees with long, broad, spiny-edged leaves. Trunks may be 6 inches in diameter.	Casuarina trees require cutting or blasting; smaller trees of other types of forest require cutting by power or hand saws; can be grubbed by angledozers. Paths through dense undergrowth can be hacked out with bolos.	Wood of Casuarina is very hard, heavy and somewhat difficult to saw. Makes excellent firewood; is suitable for house posts that last 6 to 7 years. Other types of beach vegetation are scrubby; of little value.	Vehicles. Casuarina stands offer little obstruction to cross-country movement. Spacing of trees irregular, but in many places lanes are wide enough for trucks. Sandy soil will support free movement. Other types of trees may have thick undergrowth that obstructs movement. Pandan trees grow fairly thickly; not difficult to clear way for wheeled vehicles; probably no clearing required for tracked vehicles. Foot Troops. Movement on Casuarina beaches generally unimpeded. On some other beaches cutting of paths necessary. Broad, spiny-edged leaves of pandan trees are a nuisance; cutting of paths not difficult.	Visibility little obstructed in Casuarina forests where undergrowth consists only of Casuarina seedlings; may be limited to only a few tens of yards in forests of scattered trees and undergrowth.	All types of forest afford fair to good concealment from aerial observation. Concealment from ground observation depends on density of undergrowth, which differs from place to place.
1 MANGROVE AND NIPA SWAMPS	Most extensive at the mouth of Gandara River (Samar), and along San Juanico Strait between Samar and Leyte. Mangrove forests grow in salt and brackish water; generally occupy narrow belt a few yards to 1 or 2 miles wide; extensive around river mouths in heads of protected bays. Extent upstream limited by mud and tides; mangroves fringe streams; at high tide, water 3 to 4 feet deep in mangrove swamps; at low tide, wet and muddy ground may be exposed. Forests interrupted by tortuous tidal channels. Nipa palms tolerate fresher water; in places grow on inner margin of swamp, bordering estuaries, and fringing lower courses of rivers; in large areas they form dense pure stands, without undergrowth; in places are mixed with other forms; locally grow on seaward edge of swamp.	Mangrove forests contain several kinds of trees; some 80 to 100 feet high and 2 feet or more in diameter, but generally smaller. Trees form dense stands with nearly closed overhead canopy; little undergrowth. Various kinds of air roots extend upward to high-water level; these may be straight, vertical, stick-like roots standing close together, or dense tangles of curved roots (convex upward and outward from trunk). Nipa palms have creeping stems that send up clumps of leaves 8 to 12 feet high. Generally grow in close pure stands without undergrowth, but in places mixed with mangrove and other kinds of trees. Not distinguished from mangrove on map. Interior of swamp may contain tabau trees; rarely up to 2 feet in diameter; usually scattered. In many places, straight, slender langaray trees 6 to 8 inches in diameter, rarely 16 inches, form pure stands. Large trees known as dungon-late are locally scattered along landward edges of swamps.	Trees must be felled by hand or power saws. Logs and roots, where accessible to land equipment, can be removed by tractor and angledozer; elsewhere they can be dragged out by winch and cable attached to boats. Nipa and tangles of mangrove roots can be cut out with saws and bolos.	Mangrove is used primarily for firewood. Larger trees have hard, heavy, rather straight-grained wood that is strong enough for house posts and can be used for temporary construction; in the ground, wood lasts 5 to 8 years. Slender trunks of langaray trees (6 to 8 inches in diameter) are useful for temporary piling and will last 1 to 5 years. Dungon-late trees furnish a strong, exceedingly tough wood suitable for heavy construction; one of the few local woods that can withstand repeated shocks; recommended for bridge timbering. Tabau trees, if sufficiently large, furnish wood of excellent durability for salt-water piling. The bark of several species of trees contains much tannin, widely used for staining and preserving fish nets and useful for preserving other fabrics, such as camouflage nets; stain is brown. Principal use of nipa is for making prefabricated thatching, which lasts 5 to 7 years.	Vehicles. Barrier areas. Even where cleared, areas are impassable because of soft muddy ground which at high tide is under 3 to 4 feet of water. Foot Troops. Going is difficult. Foot travel is practically impossible at high tide when ground is flooded. At low tide, footing is bad because of soft mud and many air roots, which in many places are covered with sharp-edged shells. Common practice is to walk on top of the tangle of air roots, using trunks and branches for support; footing poor on slippery roots. Many deep, muddy tidal channels. In places at landward edge of swamp are thick tangles of vines and other undergrowth. Nipa palms are dense and difficult to penetrate. Crocodiles are common and sometimes troublesome. Poisonous snakes are commoner, but are sluggish and rarely cause trouble. Biting flies and mosquitoes, sometimes very abundant, are the most disagreeable feature of the swamp. Boats. At high tide, landing craft and canoes can push through mangrove forest in many places; at low tide, passage confined to tidal channels. Pentration of nipa forest is difficult as water is generally too shallow; passage along open channel possible; abundant nipa along a channel indicates fairly deep water.	Visibility generally restricted to a few score feet.	Concealment of personnel from ground and aerial observation is excellent.
2 CULTIVATED LAND	Cultivation on Samar is confined largely to coastal fringe and to parts of valleys of Dolores, Oras, Catubig, Catarman, and Ulut Rivers. A higher proportion of Leyte is cultivated, chiefly wide coastal areas. Cultivated land, as mapped, contains much secondary forest and grassland, the amount and distribution of which differs from year to year. Following refers mainly to crop land. Principal crops are abaca' (Manila hemp), coconuts, rice, sweet potatoes, corn, tobacco, and sugarcane. Cattle are raised in northwestern Leyte. Abaca is grown on well-drained soil, commonly on hills beneath forest cover. Coconut palms generally are grown on sandy soil or near the beaches; some cultivated inland. Irrigated rice is grown extensively in lowland areas; dry, upland rice grown in small cleared patches in hilly country. Sugarcane is planted on well-drained ground. In hilly country that has poor soil cultivated land commonly farmed only few years; then allowed to revert to cogon grass and secondary forest.	Coconut palms are planted in regular rows, 30 feet apart or more; generally 30 to 50 feet high, but may be over 80 feet; trunks 8 to 12 inches in diameter; in many places, form a fairly close canopy; canopy open in places. Abaca' (Manila hemp), a kind of banana plant forms dense growth 12 to 18 feet high and shades the soil which is usually moist. It reproduces by suckers from the base of the stem; therefore alignment usually irregular. Irrigated or lowland rice land is divided into small level paddies enclosed by earthen dikes 1 to 4 or 5 feet high and 2 or more feet wide. At harvest time, most rice fields are dry; ground softens quickly during rains. Sugarcane makes dense growth a few feet to 12 or 15 feet high; some special varieties are taller. Bamboo is uncommon; forms dense clumps and thickets.	Coconut palms can be readily pushed over by tractor; can be cut by hand saw. Abaca', banana, sugarcane, and most other cultivated growth readily cleared with bolo knives.	Food crops. Abaca', the most important export crop, is made into rope; used locally for fabrics. Trunks of coconut palms, generally 8 to 12 inches in diameter, useful for constructing temporary corduroy roads on boggy ground, temporary retaining walls, and other similar structures.	Vehicles. Free movement in coconut groves wherever slope and ground permit. Some easy clearing may be necessary in abaca' fields. Irrigated rice fields difficult to cross when wet; those on higher ground can be drained by breaking dikes; when dry, are firm and readily crossed by wheeled vehicles; ground quickly becomes muddy during rains. Foot Troops. Movement easy except in wet rice lands which are most easily crossed by paths on dikes.	Visibility good in most places; poorest in abaca' plantations and secondary forest.	Concealment for vehicles and personnel from aerial observation but not from nearby ground observation afforded by most coconut groves. Abaca' plantations provide fair to good concealment for personnel from ground and aerial observation; concealment for vehicles is poor to fair. Tall sugarcane provides excellent concealment for personnel from ground and aerial observation.
3 GRASSLAND	Large, burned-over and abandoned areas are occupied by coarse cogon grass, which grows from sea level to altitudes above 5,000 feet on all types of terrain except permanently swampy ground. Its presence generally indicates well-drained ground; other somewhat similar grasses may occupy swampy land.	Cogon is a very coarse wild grass generally 2 to 5 feet high; in moist localities, such as valley bottoms, up to 8 feet high; forms low, thick mantle; burns readily when dry and makes a quick hot fire; grows back quickly after burning.	In dry months, cogon grass can be readily cleared by burning; at other times, by mower or by hand.	Young shoots of cogon grass make rather poor forage; older grass is too harsh. Bundles of cogon widely used for thatching.	Vehicles. Generally passable to motor traffic where slope and ground permit. Larger permanent streams flowing through grassland areas are generally bordered by shrubs or trees. Very small or intermittent streams and the gullies they follow may be concealed from ground observation by the dense grass; are hazards to movement off trails. In dry months, large grass fires spread swiftly. Foot Troops. Movement off trails possible everywhere but tiresome owing to density and coarseness of grass, to an irritating dust from dry leaves, and to intense heat. Sharp blades of grass cut skin; trampled grass gives slippery footing on slopes, but grass clumps provide handholds.	Visibility excellent where grass is not too tall.	Where tall, cogon grass provides good concealment from ground observation but not from aerial observation.
4 SECONDARY FOREST	Secondary forest may occupy any kind of terrain except swamps; covers large areas where primary forest was cut and burned to permit cultivation. After short period of cultivation, such cleared areas are abandoned and generally revert to cogon grass, which in turn is replaced by secondary forest. Ultimately, secondary forest becomes primary forest.	Where clearing was comparatively recent, secondary forest consists of an exceedingly dense growth of low, mostly softwood trees and vines, with scattered large, partly rotted logs; especially common at edges of primary forests. Where original forest was cut many years ago and fires have been frequent, there are open, park-like grassy areas with scattered thickets of scrubby trees.	Clearing of dense thickets requires much cutting and some blasting and grubbing with clearing equipment. Paths for foot troops can be cleared with bolos.	Secondary forest has little value. Wood is soft and small; makes fair firewood. Some kinds can be used for light temporary construction; most are useless.	Vehicles. Free movement in open, park-like areas where slope and ground permit. Wheeled vehicles cannot move through dense secondary forest; heavy clearing required. Tracked vehicles can penetrate some young secondary growth. Foot Troops. Movement slow and difficult in dense thickets of young secondary forest, and necessitates much cutting; easy in open, park-like areas.	Visibility limited to a few yards in dense thickets; good in open, park-like areas.	Dense thickets provide good concealment for personnel and parked vehicles; open, park-like areas offer limited concealment.
5 PRIMARY FOREST	Primary forest widespread in higher hills and mountains and on some lowlands; originally covered nearly all the land area. Humidity is higher in primary forest than in any other type of vegetation, except mossy forest. In primary forest greatest humidity is near ground. At higher altitudes, where humidity is always high and for long periods approximates complete saturation, primary forest gives way to mossy forest; altitude of transition may be 3,000 feet or higher, depending upon cloud level.	Many big trees tower over successively smaller trees. Forest canopy shuts out sunlight almost completely; may be 100 to 150 feet high with some higher trees. Spacing of trees irregular; in many places wide enough to permit passage of trucks. Trunks up to 6 feet or more in diameter; many have large buttresses (vertical supporting walls) a few inches to a foot thick, 10 to 20 feet high, and extending 10 to 20 feet out from trunks. Undergrowth may be fairly dense, but is negligible in many types of forest. At edge of forest, a dense secondary growth of vines and creepers forms a wall generally only a few yards wide but reaching to tops of trees. Some forests badly damaged by typhoons; many fallen trees. Mossy forest consists of dwarf trees, which, at lower edge of forest, 40 feet high but are smaller at higher altitudes. Near ground, many roots grow above ground; form tangles 3 or 4 feet high. Leaves, branches, trunks, exposed roots, and ground covered with spongy, soggy mats of moss and similar growths.	Heavy equipment and blasting required to remove large trees. Undergrowth can generally be removed by hand tools. In drier months burning of high forest can be promoted with some difficulty; practically impossible to burn saturated mossy forest.	Forest provides many kinds of excellent timber suitable for light and heavy construction. Fallen trees are ready source of firewood.	Vehicles. In many places, movement through high forest nearly unimpeded by vegetation; elsewhere, especially at edge of forest, cutting of vines and undergrowth is necessary; clearing necessary in mossy forest. Areas swept by typhoons may have many fallen trees. Foot Troops. Going is easy in high forest; some cutting of vines and small growth may be required. Going is difficult in dense growth at edge of forest. In mossy forests, low distorted branches and tangles of exposed roots, largely festooned and concealed by damp mosses, make going slow and difficult. Sounds are quickly absorbed in mossy forest; movement makes little noise.	In many places it is impossible to see more than 20 or 30 yards in any direction. Some treetops provide lookouts.	Dense forest canopy gives perfect concealment from aerial observation. Good concealment from ground observation provided by larger trees, especially those with broad buttresses; trunks afford limited cover from small-arms fire.

Prepared by U. S. Geological Survey for Chief of Engineers, U. S. Army.

SAMAR AND LEYTE(P.I.)

Map No. and Vegetation Type	Distribution	D
SANDY BEACH Not shown on map; for locations, consult terrain sheets in this folio, C. and G.S. charts, or Coast Pilot and other Intelligence reports.	Beaches commonly narrow; in places only a few yards wide. On bold coasts the inland flora may grow to the sea; no distinct beach flora present. Settlements common; in many places original forest has been cleared for cultivation (see Cultivated Land). In places Casuarina forests occupy narrow belts along coast, and small pure stands may also occur on sandy flood plains of larger rivers. Elsewhere are several kinds of scattered trees; the pandan, or screw pine, may be abundant.	<u>Casuarina type</u>. C trees, 60 to 100 f feet or more in di other than Casuari ed with fallen twi regular; but canop ous. Casuarina re recognized from co <u>Other types</u>. Othe have fairly thick shrubs, vines, and low, scrubby trees edged leaves. Tru diameter.
1 MANGROVE AND NIPA SWAMPS	Most extensive at the mouth of Gandara River (Samar), and along San Juanico Strait between Samar and Leyte. Mangrove forests grow in salt and brackish water; generally occupy narrow belt a few yards to 1 or 2 miles wide; extensive around river mouths in heads of protected bays. Extent upstream limited by mud and tides; mangroves fringe streams; at high tide, water 3 to 4 feet deep in mangrove swamps; at low tide, wet and muddy ground may be exposed. Forests interrupted by tortuous tidal channels. Nipa palms tolerate fresher water; in places grow on inner margin of swamp, bordering estuaries, and fringing	<u>Mangrove forests</u> c trees; some 80 to more in diameter, Trees form dense s overhead canopy; l kinds of air roots level; these may b like roots standin tangles of curved ward from trunk). stems that send up feet high. Genera without undergrowt mangrove and other distinguished from of swamp may conta 2 feet in diameter many places, strai 6 to 8 inches in d

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escription	Reliability: Good Clearing and Grubbing	Uses	
asuarina are medium-sized eet tall and 8 inches to 2 ameter. Little undergrowth na seedlings; ground carpet-gs. Spacing of trees is ir-y generally fairly continu-sembles a pine, and can be nsiderable distance offshore. r scattered trees commonly tangled undergrowth of low creepers. The pandan is with long, broad, spiny-nks may be 6 inches in	Casuarina trees require cutting or blasting; smaller trees of other types of forest require cutting by power or hand saws; can be grubbed by angle-dozers. Paths through dense undergrowth can be hacked out with bolos.	Wood of Casuarina is very hard, heavy and somewhat difficult to saw. Makes excellent firewood; is suitable for house posts that last 6 to 7 years. Other types of beach vegetation are scrubby; of little value.	Vehicles. obstructio Spacing of lanes are will suppo trees may movement. not diffic cles; prob ed vehicle Foot Troop generally cutting of edged leav cutting of
ontain several kinds of 100 feet high and 2 feet or but generally smaller. tands with nearly closed ittle undergrowth. Various extend upward to high-water e straight, vertical, stick-g close together, or dense roots (convex upward and out- Nipa palms have creeping clumps of leaves 8 to 12 lly grow in close pure stands h, but in places mixed with kinds of trees. Not mangrove on map. Interior in tabau trees; rarely up to ; usually scattered. In ght, slender langaray trees iameter, rarely 16 inches,	Trees must be felled by hand or power saws. Logs and roots, where accessible to land equip-ment, can be re-moved by tractor and angledozer; elsewhere they can be dragged out by winch and cable attached to boats. Nipa and tangles of mangrove roots can be cut out with saws and bolos.	Mangrove is used primarily for firewood. Larger trees have hard, heavy, rather straight-grained wood that is strong enough for house posts and can be used for temporary construction; in the ground, wood lasts 5 to 8 years. Slender trunks of langaray trees (6 to 8 inches in diameter) are useful for temporary piling and will last 1 to 5 years. Dungon-late trees furnish a strong, exceedingly tough wood suita-ble for heavy construction; one of the few local woods that can withstand repeated shocks; recommended for	Vehicles. areas are ground whi of water. Foot Troop is practic ground is bad becaus which in m edged shel top of the and branch slippery r In places tangles of palms are Crocodiles some. Poi sluggish a

VEGETATION

Effects on Military Operations

Movement	Observation	Concealment
Casuarina stands offer little n to cross-country movement. trees irregular, but in many places wide enough for trucks. Sandy soil rt free movement. Other types of have thick undergrowth that obstructs Pandan trees grow fairly thickly; ult to clear way for wheeled vehi- ably no clearing required for tread- s. s. Movement on Casuarina beaches unimpeded. On some other beaches paths necessary. Broad, spiny- es of pandan trees are a nuisance; paths not difficult.	Visibility little obstructed in Casuarina forests where undergrowth consists only of Casuarina seedlings; may be limited to only a few tens of yards in forests of scattered trees and undergrowth.	All types of forest afford fair to good concealment from aerial observation. Concealment from ground observation depends on density of undergrowth, which differs from place to place.
Barrier areas. Even where cleared, impassable because of soft muddy ch at high tide is under 3 to 4 feet s. Going is difficult. Foot travel ally impossible at high tide when flooded. At low tide, footing is e of soft mud and many air roots, any places are covered with sharp- ls. Common practice is to walk on tangle of air roots, using trunks es for support; footing poor on oots. Many deep, muddy tidal channels. at landward edge of swamp are thick vines and other undergrowth. Nipa ense and difficult to penetrate. are common and sometimes trouble- sonous snakes are commoner, but are nd rarely cause trouble. Biting	Visibility generally restricted to a few score feet.	Concealment of personnel from ground and aerial observation is excellent.

	lower courses of rivers; in large areas they form dense pure stands, without undergrowth; in places are mixed with other forms; locally grow on seaward edge of swamp.	form pure stands. dungon-late are lo ward edges of swam
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3 GRASSLAND	Large, burned-over and abandoned areas are occupied by coarse cogon grass, which grows from sea level to altitudes above 5,000 feet on all types of terrain except permanently swampy ground. Its presence generally indicates well-drained ground; other somewhat similar grasses may occupy swampy land.	Cogon is a very co to 5 feet high; in valley bottoms, up thick mantle; burns a quick hot fire; burning.

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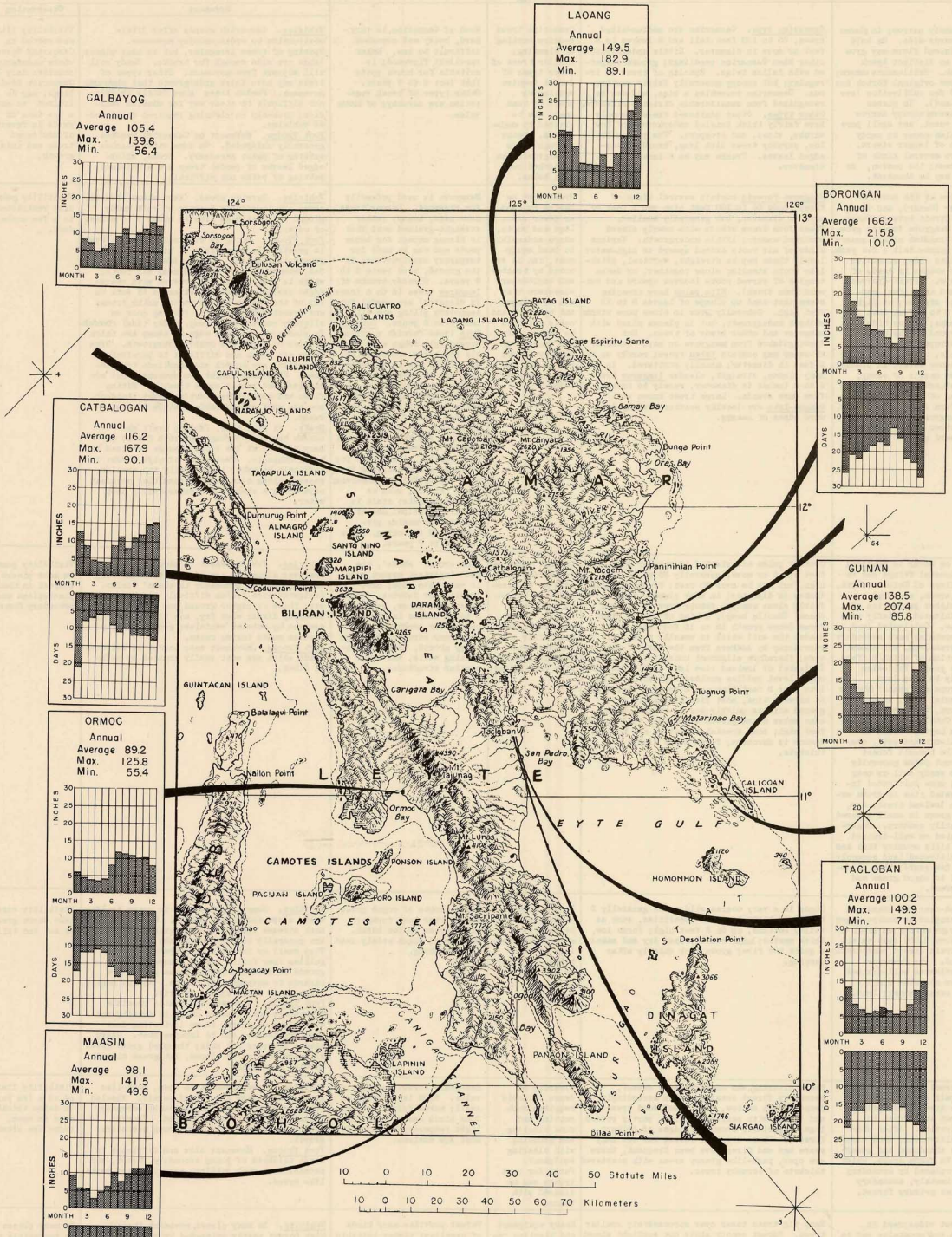
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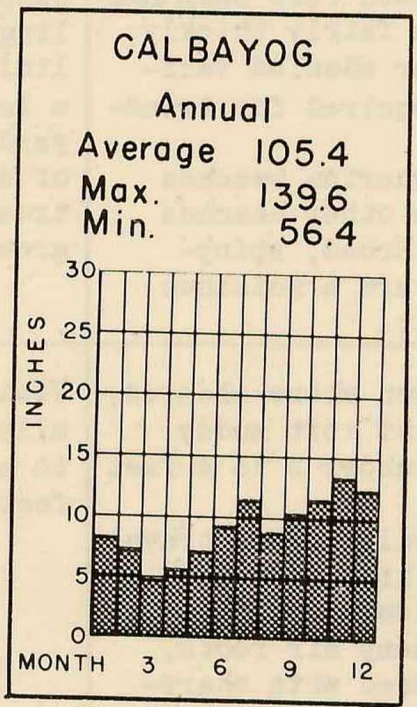
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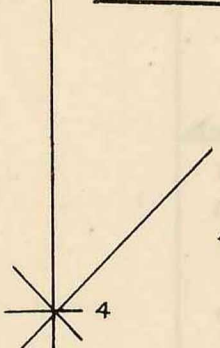


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FOR
CHIEF OF ENGINEERS, U. S. ARMY

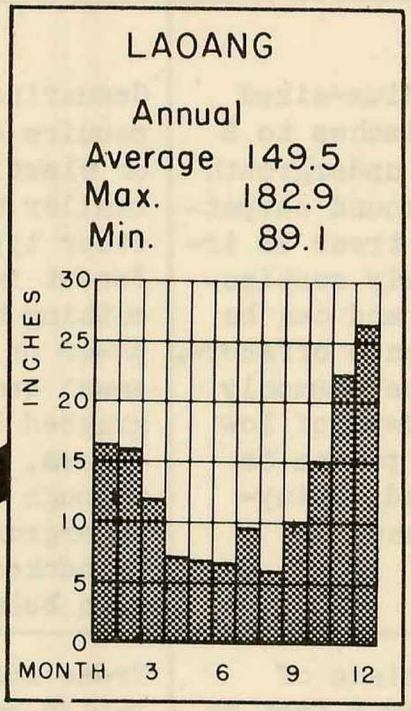
CLIMATE


CALBAYOG
Annual
Average 105.4
Max. 139.6
Min. 56.4
INCHES
30
25
20
15
10
5
0
MONTH 3 6 9 12


124°
Sorsogan Bay
2821
CAPUL ISLA


4

[redacted]



125°

usan Volcano

San Bernardino Strait

BALICUATRO ISLANDS

BATAG ISLAND

220

LAOANG ISLAND

Cape Espiritu Santo

DALUPIRI ISLAND

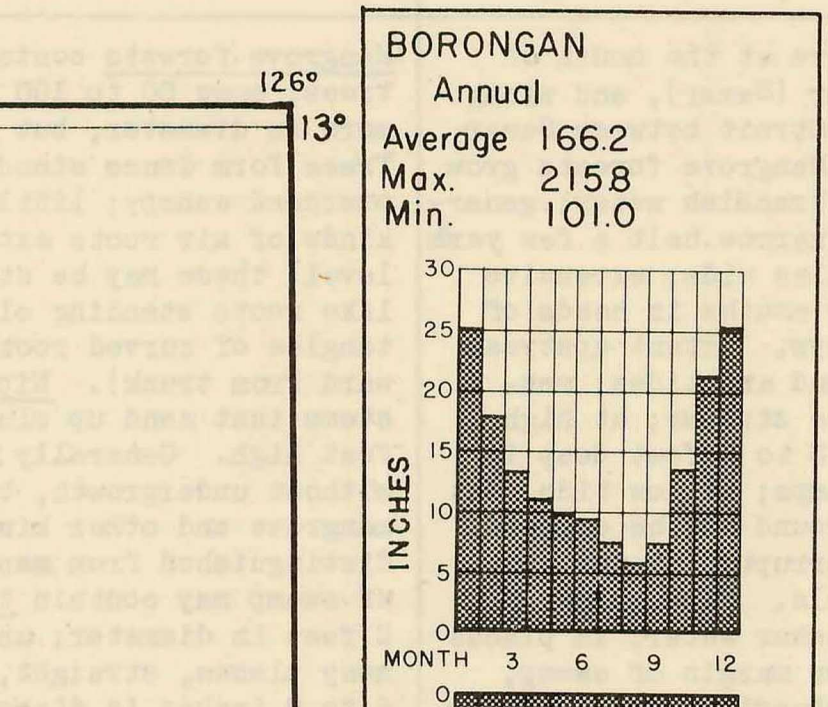
832

1383

1229

RIVER

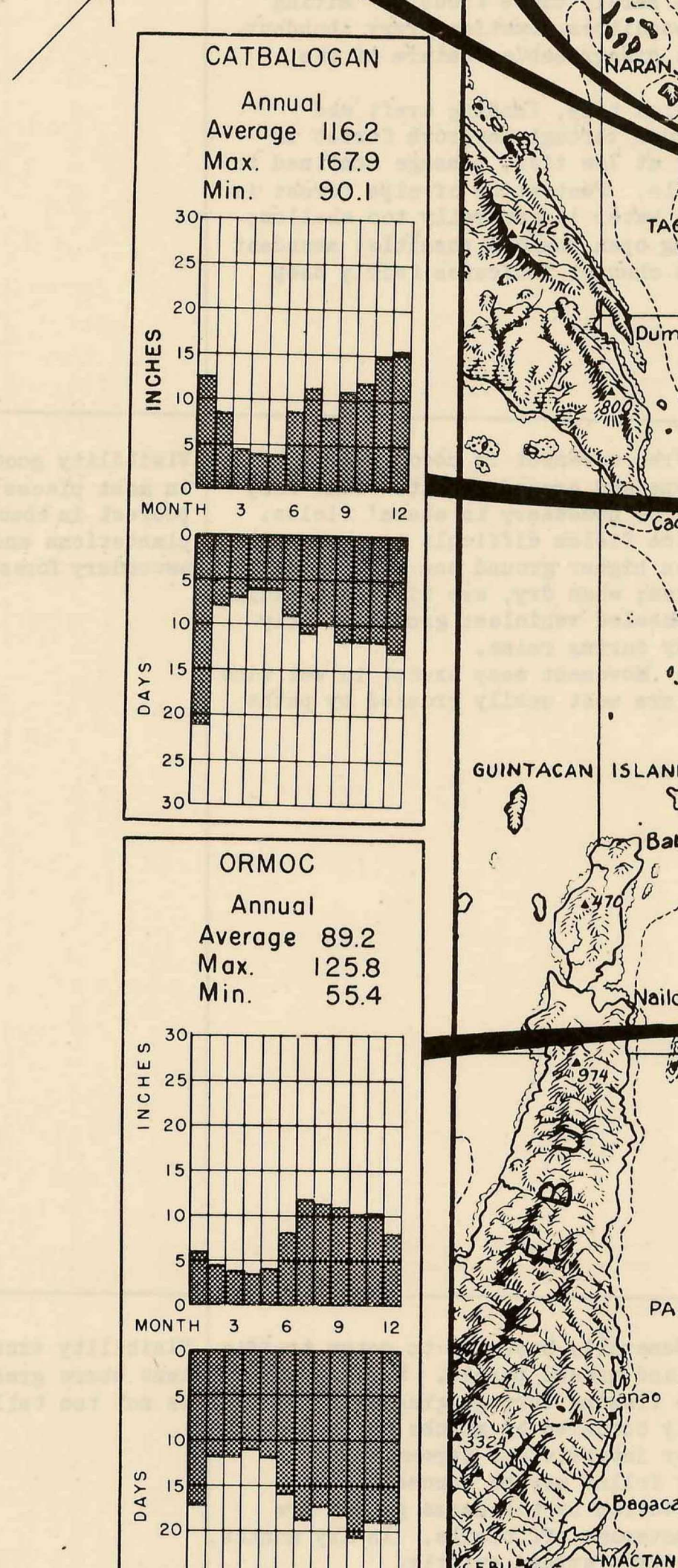
SAMAR AND LEYTE(P.I.)

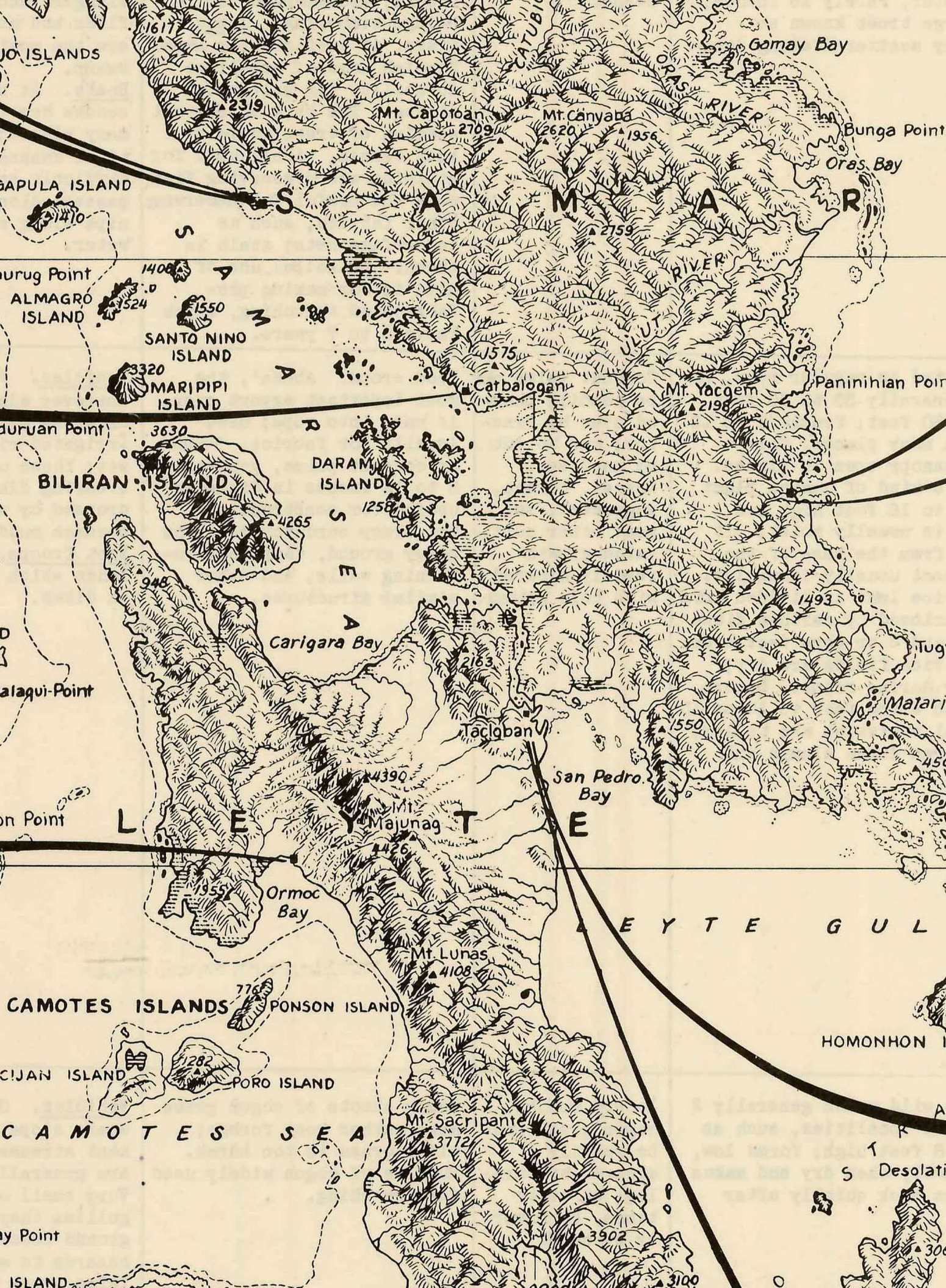


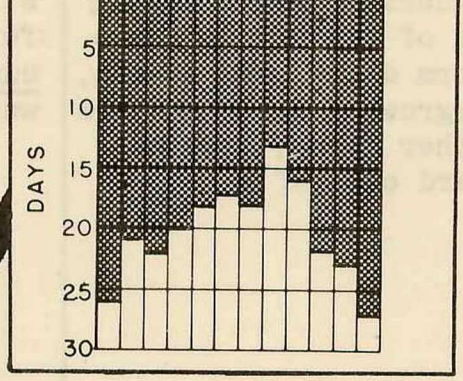
BORONGAN

Annual

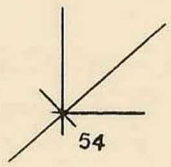
Average	166.2
Max.	215.8
Min.	101.0

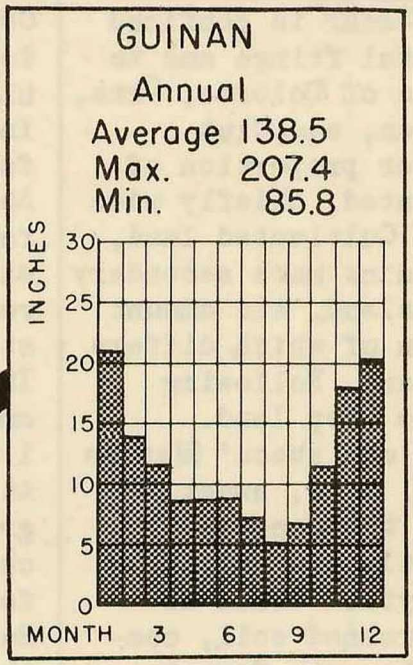

CATBALOGAN
Annual
Average 116.2
Max. 167.9
Min. 90.1
INCHES
MONTH
DAYS
ORMOC
Annual
Average 89.2
Max. 125.8
Min. 55.4
INCHES
MONTH
DAYS
NARAN
GUINTACAN ISLAN
Danao
MACTAN


Gomay Bay
Mt. Capotoan
2709
Mt. Canyaba
2620
1956
Bunga Point
Oras Bay
S A M A R
2159
ALMAGRO ISLAND
1524
1550
SANTO NINO ISLAND
3320
MARIPIPI ISLAND
1575
Catbalogan
Mt. Yacgem
2198
Paninihian Point
3630
BILIRAN ISLAND
DARAM ISLAND
1258
4265
948
1493
Carigara Bay
2163
Tacloban
1550
San Pedro Bay
4390
Majunag
4426
1955
Ormoc Bay
L E Y T E
Mt. Lunas
4108
CAMOTES ISLANDS
PONSON ISLAND
1282
PORO ISLAND
CAMOTES SEA
Mt. Sacripante
3772
3902
HOMONHON
Desolation



12°



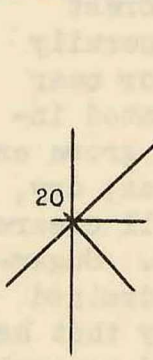


nug Point

nao Bay

CALICOAN ISLAND

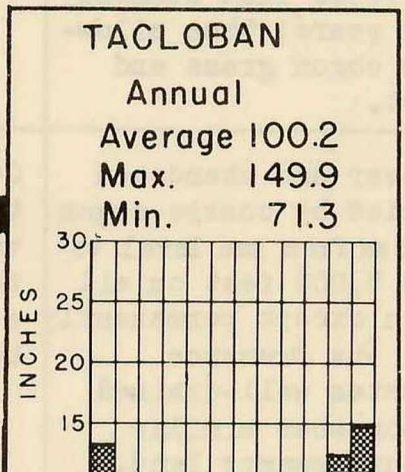
11°



1120

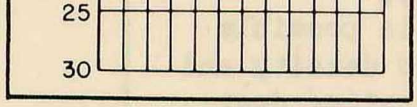
340

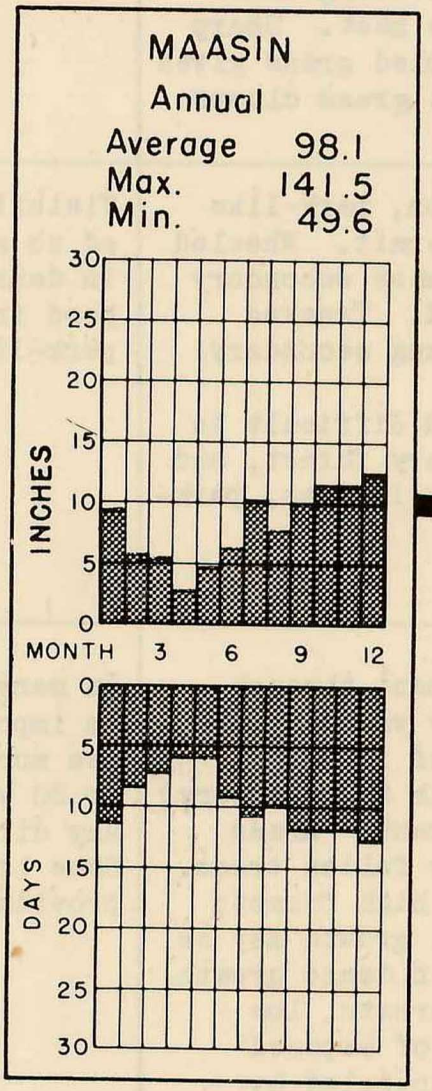
SLAND



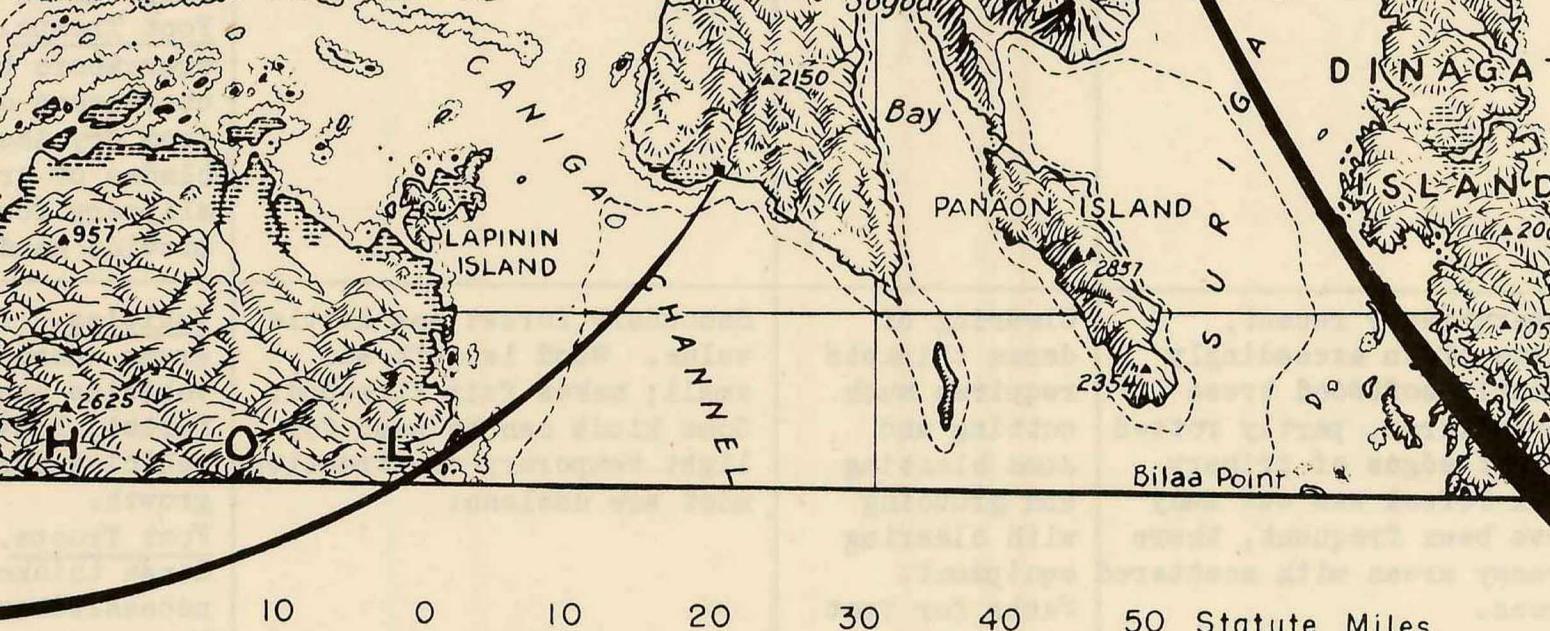
on Point

66


25
30


MAASIN
Annual
Average 98.1
Max. 141.5
Min. 49.6
INCHES
0
5
10
15
20
25
30
MONTH 3 6 9 12
DAYS
0
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10
15
20
25
30


B
O



10 0 10 20 30 40 50 Statute Miles

10 0 10 20 30 40 50 60 70 Kilometers

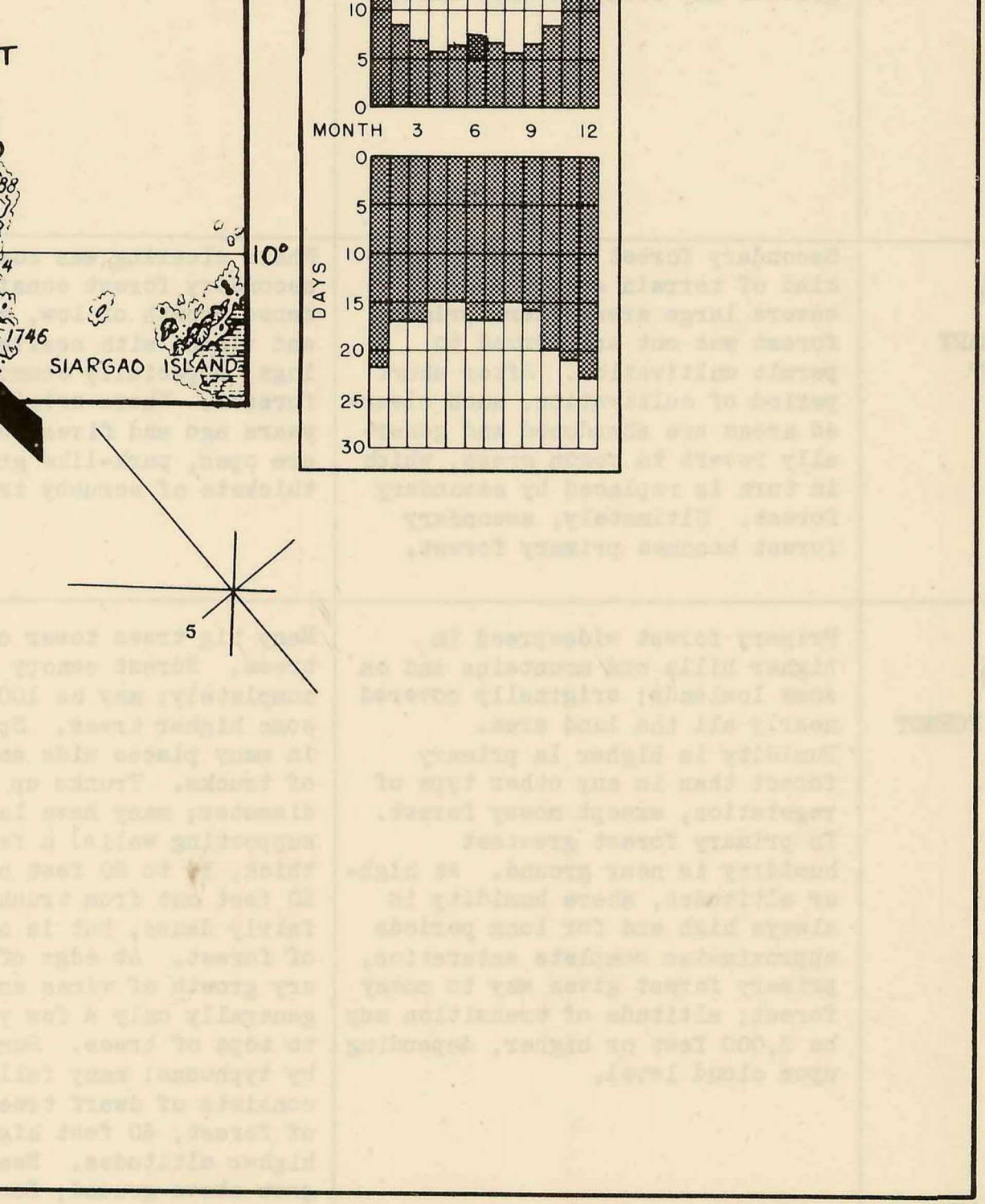
EXPLANATION OF WIND ROSES

0 5 10 20 30 40

Percentage of total wind in indicated direction.

Small number denotes % of calm.

[redacted]



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FOR
CHIEF OF ENGINEERS, U. S. ARMY

SAMAR AND LEYTE (P.I.)

Sources:
Selga, Miguel, Observations of rainfall in the Philippines, Weather Bureau, Govt. Phil. Is., Dept. Agr. and Commerce, 289 pp., 118 pl., 1935.
Annual Report of the Weather Bureau, 1938, Parts I and II, Commonwealth of the Philippines, Dept. Agr. and Commerce, 144 pp., 1939.
Annual Report of the Weather Bureau for the year 1939, Part III, Commonwealth of the Philippines, Dept. Agr. and Commerce, 393 pp., 1940.
Climatology of the Pacific Islands, AFT SW no. 332, Headquarters, Army Air Forces, Directorate of Weather, Climatological Division, 121 pp. (typed), no date.
Census Atlas of the Philippines, Census of the Philippines, 1939, vol. 5, Manila, 1941.
Naval Air Pilot, Philippine Isands, Hydrographic Office, no. 185, 1937.

Introduction

Samar and Leyte have a tropical climate characterized by high precipitation and humidity and uniformly high temperatures. The abundance of typhoons (severe tropical cyclonic storms) is the outstanding feature in this area. The following summary is a compilation of facts readily available and is not intended as a detailed weather guide. Other intelligence sources should be consulted for authoritative weather information.

Rainfall

Average annual precipitation on Samar and Leyte ranges from 86 inches to 165 inches. Rainfall is greatest on the east and north sides of Samar, where the predominant northeast winds blow from the open ocean. The least rainfall is on the west sides of Samar and Leyte. The rainfall is probably greater at higher altitudes in the interior of both islands, but no records are available. Rainfall on the islands is distributed throughout the year with no pronounced dry season. The maximum precipitation occurs in winter on the east sides in the path of the northeast winds. The absolute maximum and minimum precipitation for any month may differ widely from the average; similarily, the annual total may range from 1/2 to 1 1/2 times the average.

The rainfall is occasionally of great intensity. Precipitation of 4 to 9 inches in a 24-hour period may occur on 2 to 8 days a year. These periods of heavy rainfall are most frequent during the winter months. Floods result from torrential rains. The increased discharge rarely lasts more than a day or two, the runoff returning quickly to normal. On Leyte, where the rainfall in the mountainous interior is greater, flood discharges are usually 2 to 10 times normal flow, and rarely as much as 20 times.

Periods of little or no rainfall, during which precipitation on any day is less than 0.4 inch (10 mm), may last 2 to 6 weeks or longer, especially in spring and summer.

Humidity

Humidity is high throughout the year, averaging over 80%.

Temperature

Mean annual temperature at sea level is about 80°F; the absolute range is from 65°F to 97°F. There is little seasonal change.

Winds

The climate of Samar and Leyte, like that of the Philippines as a whole, is governed by the prevailing winds. During winter and spring they are northeasterly; during summer, southwesterly and southerly. Cyclonic storms are most abundant in autumn, when wind directions are variable. Local wind directions may be changed drastically by topography, as at Tacloban (see wind rose on map).

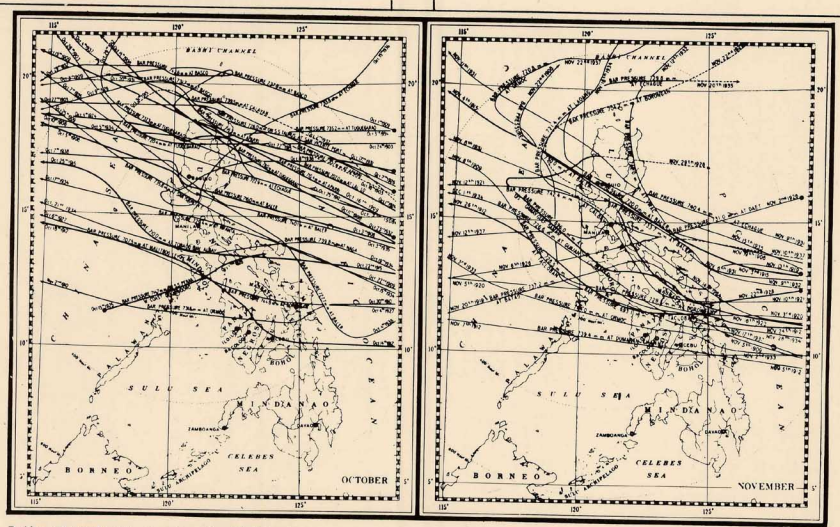
Surface wind velocity averages 3 miles per hour at Borongan (apparently sheltered), and 7 miles per hour at Tacloban, and Calbayog (Samar). Northeast and east winds are fairly steady from day to day and show little diurnal variation. The southwest wind is just the reverse. The early morning is a period of very light winds which increase to a maximum in the early afternoon when the winds are usually gusty. At night, the wind is very light or calm. In general, the surface winds will not be strong enough to hinder flying except during thunderstorms and typhoons. Thunderstorms with strong winds are local and of a few minutes duration. Typhoons are very destructive, frequently reaching velocities above 100 miles per hour; the velocities and direction of wind depend upon the location of the center. Beyond 200 miles from the center the winds average less than 20 miles per hour. Inside the danger zone of 200 miles from the center, the velocity may increase from this figure to hurricane winds within 25 miles of the center.

Most typhoons originate near Guam or Yap Islands and travel westward across the Philippines. An average of 5 severe ones annually reach the Philippines, and about 1 of these crosses Leyte or Samar. Major typhoons have occurred in all months of the year except February and March, but the main season is July to December. In the period 1902-1938, 30 typhoons struck Leyte or Samar; of these, 12 occurred in November, 3 each in January, June, October, and December, and 2 each in April, May, and September. The paths of the major typhoons that reached the Philippines during the months of October and November in a 35-year period are shown on the accompanying maps.

Typhoons travel at an average velocity of 12 miles per hour, with a range from stationary to 40 miles per hour; 70% of the typhoons travel at a velocity within 2 miles of the average.

Cloudiness and Visibility

Cloudiness in winter averages 62-71%; in spring, 53-60%; in summer, 66-70%; in autumn, 70-71%. Visibility is generally good except during rains. Dense fog is rare.



Paths of typhoons crossing the Philippines during months of October and November for a 35-year period (1903-1938)
(Census atlas of the Philippines Census of the Philippines, 1939, vol. 5. Manila, 1941.)

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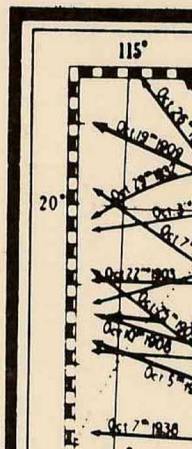
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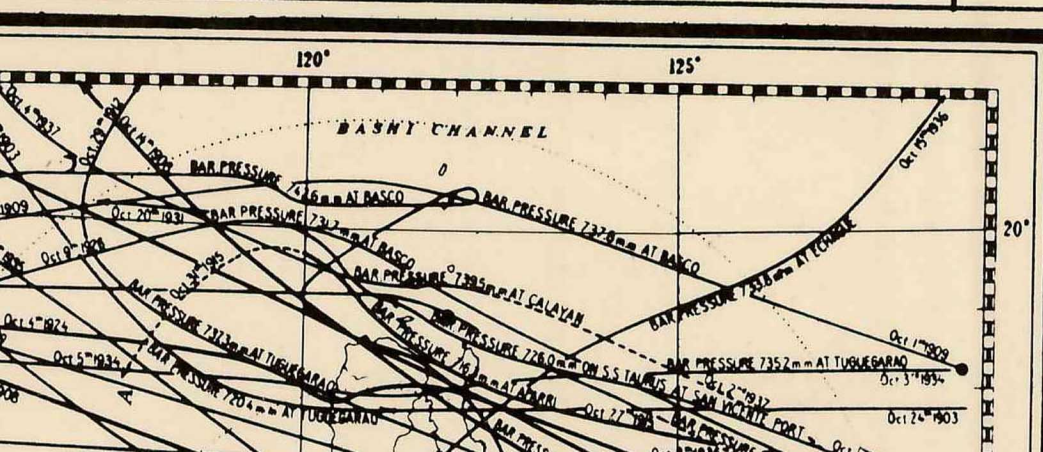
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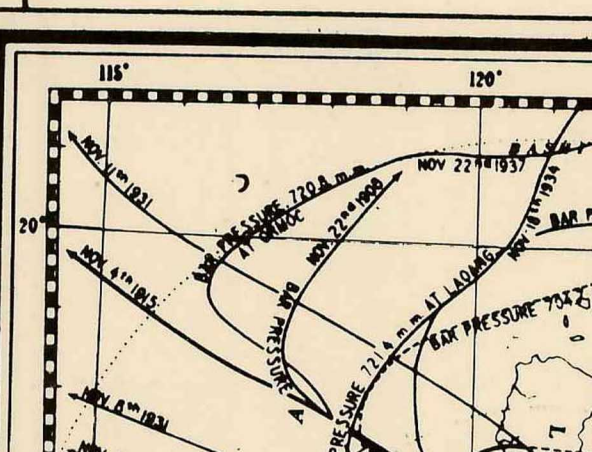
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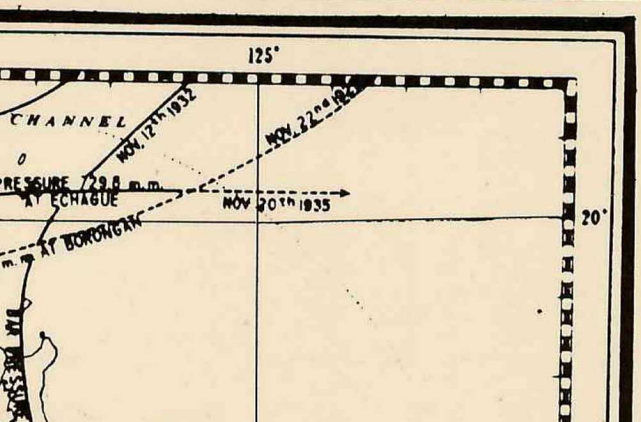
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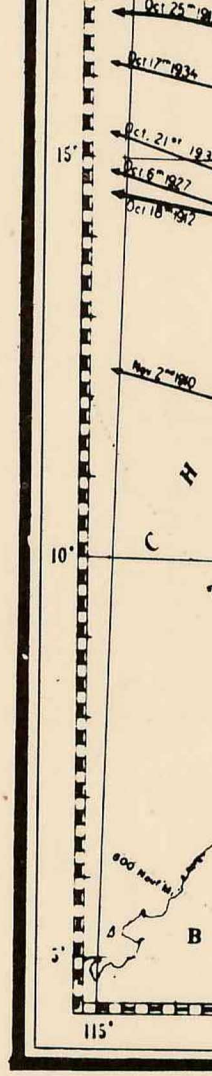
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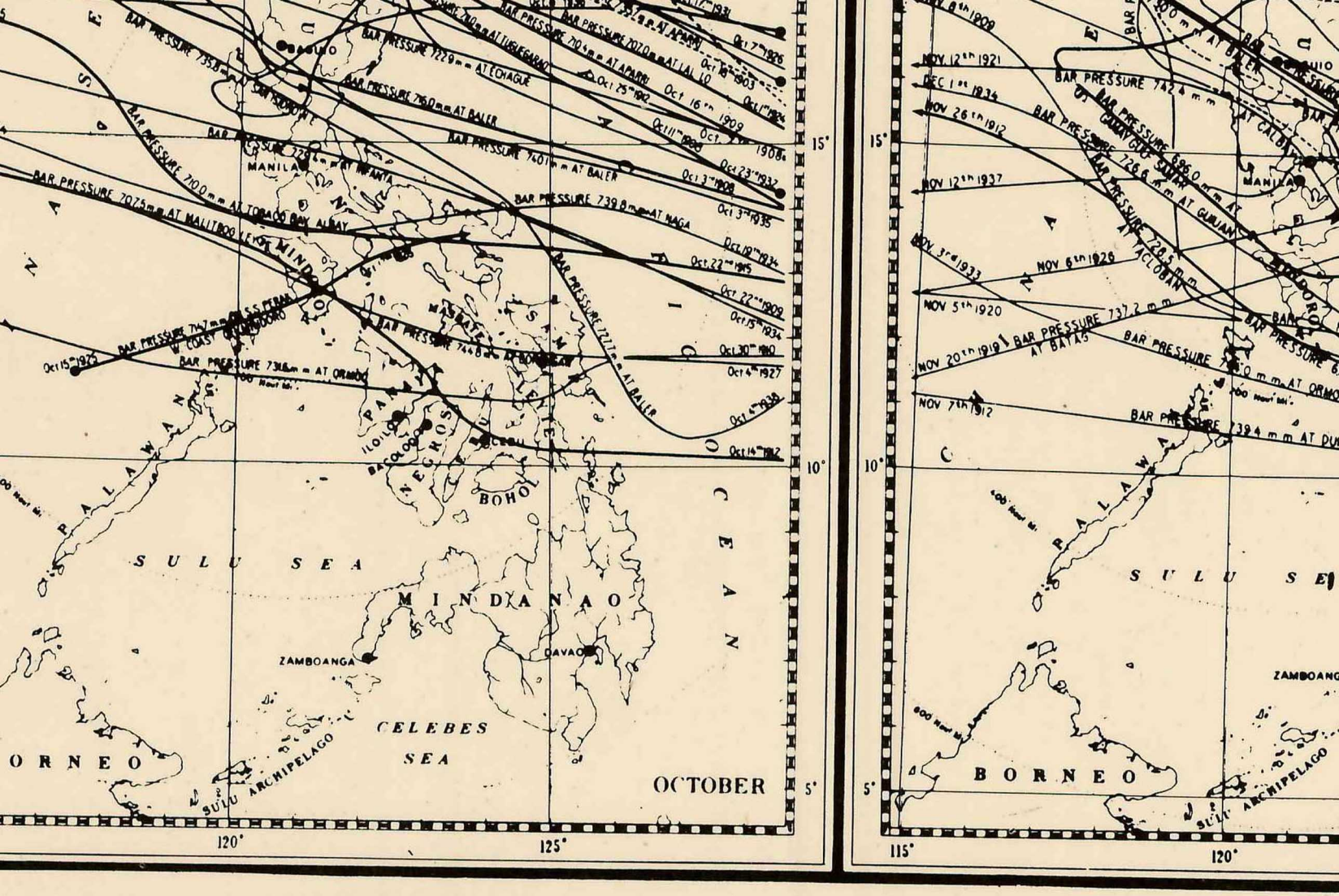
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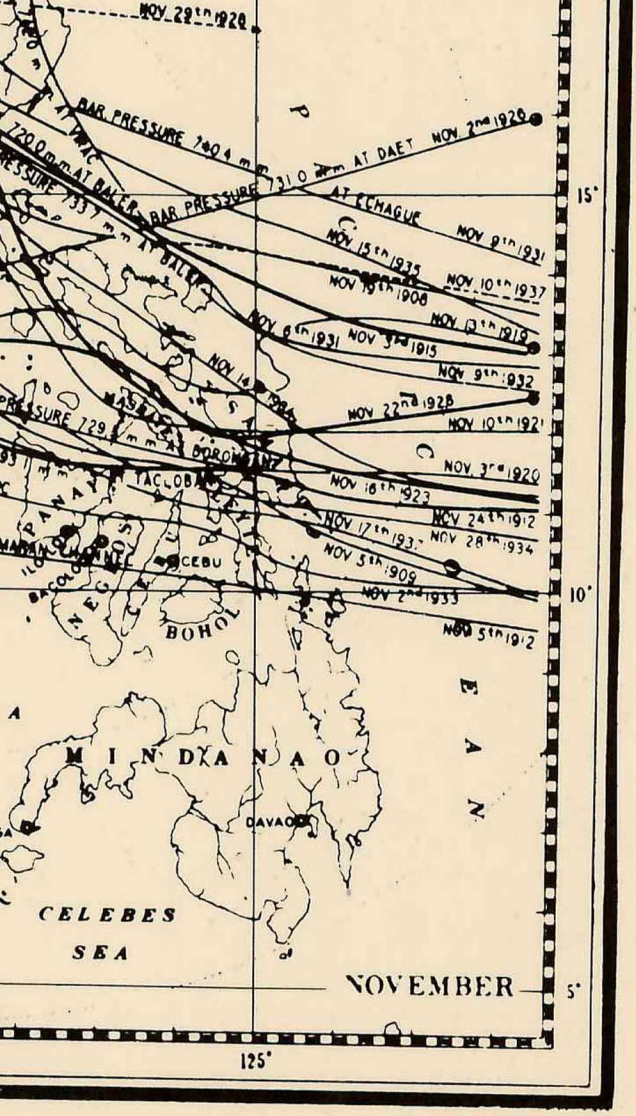


Paths of



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